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the OIL AND GAS JOURNAL

PUBLISHED WEEKLY

Aug. 24 1959

TN 860 .03

El Paso, Signal enter multigrade marketing ▸ 38

LPG industry faces a market upheaval ▸ 48

Lakehead's new satellite pumping stations ▸ 66

Property variation in petroleum reservoirs ▸ 93

New correlation for two-phase pipeline flow ▸ 100

OIL'S Centennial Celebration

Titusville, birthplace of oil, will be host this week at its 100th birthday party

p. 44

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OIL AND GAS JOURNAL
Vol. 57 No. 35

Contents August 24, 1959

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TECHNOLOGY—OPERATION

Pipelining

Lakehead Pipeline Installs New Electrically Powered Pumping Stations 66

By E. B. Turner and W. D. Wiest

Here are the latest concepts in unattended remotely controlled pipeline pumping stations of the general type in use for a number of years. The newer stations use new techniques and practices and thus have many factors not found in stations only a few years older. These include: (1) electrical pressure-control system; (2) automatic-load control; (3) unitized electrical design; (4) grouping of all controls in one factory-wired and assembled panel; (5) an electrical protection system for station pressures; and (6) supervisory systems with digital telemeters.

New Correlation for Two-Phase Flow 100

By Dr. Jose A. Chavez

This correlation relates the different variables which have apparent effect upon the two-phase flow of fluids in pipelines. The average deviation was determined to lie between 6% and minus 5%.

Refining-Processing

Ireland's First Refinery Is Now on Stream 74

The new Cork plant processes 39,600 bbl. per stream day. It makes products for Caltex, Esso, and Shell-Mex and BP, the three major companies selling on the Irish market.

How First Electrostatic Desulfurizer Has Performed for Cities Service 78

By K. C. Youngblut

This installation went into operation at East Chicago in October 1958. Spent alkylation acid is the primary treating agent. The process appears to be competitive and efficiency of sulfur and trace contaminants removal has been high.

A Look at Ethylene Glycol Today 85

By Peter W. Sherwood

Estimated U. S. production of ethylene glycol in 1958 was nearly 1.2 billion pounds. About 90% of this was obtained by the hydration of ethylene oxide. Output of this chemical has doubled since 1951 when 597 million pounds was made.

Questions on Technology 91

What's the optimum refinery size?

Tank Gaging Now Automatic at Port Moody 99

All tanks at British American's refinery can be gaged in 20 minutes using a new electronic system.

New Correlation for Two-Phase Pipeline Flow 100

By Dr. Jose A. Chavez

Drilling

New Rubber-Sleeve Core Barrel Gets Good Cores 75

By B. L. Austin

This new tool has been proved in extensive tests in fields of the United States and Venezuela where high percentages of recovery and excellent quality cores were obtained. Since the cores are packaged in the rubber sleeves as they are cut, there is no flushing of the core by well fluids after cutting. Core has no compressive load and cannot be wedged in the barrel.

Production

Material-Balance Calculations in a High-Relief Oil Field 93

By H. K. Grant

Accuracy of reserve calculations depends on recognition of fluid property variations with elevation. The saturation pressure-elevation relationship is the most critical factor in reserve estimates. Tank-oil gravity, reservoir temperature, gas solubility, gas density, and liquid-phase compressibility also vary significantly.

The OIL AND GAS JOURNAL Newsletter

Tulsa, Okla.
August 24, 1959

Whiting strike settlement may set a pattern:

Indiana Standard apparently protected its management prerogatives in settling the dispute.

Company avoided a no-layoff proposition and won the right to create a refinery common labor group by consolidating a number of small work forces.

Union was granted a plan to offset overtime, thus spreading out the work and preventing layoffs (p. 54).

▼ ▼ ▼

President's veto of Alaskan leasing bill has infuriated the new state's congressmen.

They are directing their ire at Interior Secretary Seaton, blame him for urging a veto on Eisenhower.

Bill would have doubled the amount of federal land an individual or company may have under lease or option from 300,000 to 600,000 acres. Larger limits would encourage earlier exploration, bill's advocates contended (p. 42).

Other Washington notes:

...Stage is set for gasoline tax increases. House ways and means committee has approved temporary 1-cent boost from 3 to 4 cents per gallon until June 30, 1961. After that some highway-user taxes will be diverted to help pay for the big road-building program (p. 39).

...Transwestern Pipeline Co. will return to FPC and ask a revision in the order authorizing its pipeline from Southwestern gas fields to California. The FPC in its permit cut price producers will get for the gas moved on line (p. 57).

...Another lease sale in Gulf of Mexico off Louisiana and Texas is planned by the Bureau of Land Management. Oil men may nominate areas for leasing until September 25 (p. 43).

▼ ▼ ▼

A look at the markets:

Gasoline prices are holding up well in all areas. Demand is brisk and supplies ample. On the Gulf Coast no refiner is hurting to move a cargo with mid-September the earliest date of gasoline offering for spot sale. Sellers

on these are holding for present low and some are asking one-fourth cent above today's low.

Heating oils are soft with supplies ample and sales practically nonexistent. Prices are holding now around 7¾ cents for No. 2 and 8½ for kerosine.

The East Texas price cut of 20 cents by Atlantic is finding no support from other crude buyers. Consensus appears to be the cut was too late and too much.

LPG marketers are enjoying a good year.

But the industry faces some changes in the next 5 years. The big ones: A shortage of butane due to demand from refiners for use in aklylation and an oversupply of propane.

Result will be a new push for greater supplies of butane and new markets for propane (p. 48).

▼ ▼ ▼

Custom blending at the pump has won two more converts.

El Paso has started to convert its entire marketing area to multigrade pumps. This involves 400 stations in West Texas, New Mexico, Arizona, southern Utah, southern Colorado.

Company is starting at eastern edge of its territory and working west. Early reports: Substantial increases at all stations where pumps installed.

Hancock has launched a multigrade program in southern Nevada by opening eight stations, five of them in Las Vegas.

El Paso will custom blend six grades, Hancock nine (p. 38).

Service stations on supermarket parking lots will be opened by Food Fair Stores, Inc., at 100 units in its supermarket chain.

Initial plans call for 24 within next year and 100 in foreseeable future. Private brand "FF Gasoline" will be marketed.

Food Fair already has six such stations in Philadelphia area. They were acquired when it bought Best Markets, Inc. Food Fair officials see "real potential" in the stations.

West Germany's fuel-oil cartel has come apart.

It was devised to limit spread of oil markets and set prices. Object: Save some fuel markets for coal which had been taking a terrific beating from oil and causing unemployment.

Plan didn't work. Independents cut oil price, moved in to take up slack.

Germany's coal problem is almost duplicated in Great Britain where oil fast is taking markets (p. 63).

▼ ▼ ▼

First oil-gas concession in South Africa has been granted

Trans-American Mining Corp. of Canada.
The 10,000-sq.-mile tract is in the Nemid desert sedimentary basin on the west coast.

Wildcats have opened two deep Devonian pools in Chaves County, southeast New Mexico.
Both wells have good flowing potentials and both are in areas studded with dry holes. The successes west of the Drickey-Caprock trend may revive deep drilling in area (p. 119).

Drilling will start within few days on Persian Gulf wildcat that may set a depth record for the Middle East.
It's Pan American International's first well on 6,000-sq.-mile offshore concession granted by Iran. The well will try for 16,000-ft. goal in 129 ft. of water 80 miles offshore.
Well will explore a large gently folding structure which seismic work revealed (p. 60).

New interest in the far north is being created by an apparent discovery in Yukon territory of Canada.
Western Minerals 1 Chance got oil and gas shows from 4,250 to 4,415 ft. The pay zones yielded 10,000 M.c.f. of gas daily and a light gravity oil.
Area is 450 miles from Pacific, 150 miles northeast of Dawson, and 320 miles northwest of Normal Wells field, only production in the region.

▼ ▼ ▼

One of biggest gas-pipeline projects ever planned will come up for hearings this fall.
Proposed is a 1,400-mile, $330-million system to move gas from Berland River in Alberta to San Francisco. A 36-in. mainline is planned. Hearings are scheduled before Alberta Oil and Gas Conservation Board and the FPC (p. 40).

Mississippi River Fuel, which serves St. Louis with a natural-gas line from Louisiana, has become the largest stockholder in Missouri Pacific Railroad.
Outlook: Both firms may use the railroad right-of-way for a new gas line.

A new products line in Iran is planned by National Iranian Oil Co., the government company.
NIOC is receiving bids this week on a 510-mile, 8-in. line from Teheran eastward to Meshed.

Pacific Northwest Pipeline has edged into the black in its second full year of operation.
Earnings for 1958, excluding gain on sale of investment

securities, were $271,651 compared with loss of $2,067,005 the year before.

Gas pipeline from Sahara across Mediterranean to Europe is being seriously studied. It poses a gigantic engineering headache.

Major problem is kind of pipe. Two approaches now being considered by American firm are:

...Big-inch plastic pipe manufactured at the laying site on a floating factory aboard a converted aircraft carrier.

...Floating steel pipeline across Mediterranean about 300 ft. below surface (p.62).

▼ ▼ ▼

First job facing Canada's new National Energy Board is decision on five applications to export gas.

Most urgent is Trans-Canada's application to supply Midwestern, a subsidiary of Tennessee Gas. The supply contract expires November 1.

FPC approval of the deal involving more than 200,000 M.c.f. of gas daily is expected before the deadline. But the Energy Board most likely won't get around to a decision until after January 1.

▼ ▼ ▼

Five oil companies are among the 50 most popular stocks owned by monthly investment plan shareowners.

The New York Stock Exchange reports at the end of June there were 90,218 pay-as-you-go plans in effect.

Jersey Standard ranked fourth in stock popularity and was in 3,088 plans. Phillips was seventh in 2,106 plans; California Standard 21st in 999 plans; Gulf 30th in 736 and Texaco 37th in 464.

Seizure of Royal Dutch-Shell properties in Indonesia is being threatened by President Sukarno. The alternative: The Netherlands give up western New Guinea.

When Indonesia became independent 14 years ago, the Dutch retained their hold on western New Guinea and the Indonesians have resented this ever since. In 1957 the nationals expropriated all Dutch properties and forced Dutchmen to leave the country.

Shell was not bothered at that time because of its diverse ownership. Now Sukarno says this is no longer insurance for the Royal Dutch-Shell firm there.

First "home care" health insurance program (OGJ, July 6, p. 77) apparently appeals to employes.

It was made available to employes of Texaco marine terminal at Bayonne, N. J.

Result: 236 of 242 employes or 97.5% signed up.

The OIL AND GAS JOURNAL

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They Say—

Other Iowa areas leased

Dear Sir:

I read and appreciate your article in the Journal of July 27 ("Dry Hole Even Boosts Iowa's Oil Play," p. 100) as Iowa is my native state.

Sorry that you didn't shade your map in Audubon, Dallas, and Madison counties, where leases have been taken also.

A. J. Barrett
Siloam Springs, Ark.

Good system, if we'd use it

Dear Sir:

Thank you for introducing me to your system of well nomenclature. I have never seen, nor can I imagine a system that has anywhere near its clarity, conciseness, and literary flexibility. The sequence—operator, well number, lease name, lease number, could well be adopted as an industry-wide standard.

However, on the critical side, I have recently noticed an increasing proportion of your articles using other forms of nomenclature. In each case this results in one or more of the following. 1. Ambiguity as to operator or lease name, 2. increased wordage, and 3. a break in the reading rate.

May I encourage you to use your nomenclature consistently in the hope that eventually it will be adopted industry-wide.

Frank A. Getz
Whittier, Calif.

(Editor's note: Reader Getz' observation of an increasing proportion of articles using other forms of nomenclature is a direct reflection of increased activity and success in the Appalachian region, where nomenclature becomes much more complex than in the south and west. Well designations there must include not only operator, number, and lease, but township, quadrangle, and county.)

Texaco's true earnings

Dear Sir:

I note that the table on page 57 of your August 10 issue gives incorrect figures for Texaco's per share earnings for the first 6 months of 1959 and 1958.

Correct data are as follows: Texaco's per share consolidated net income for the first 6 months of 1959

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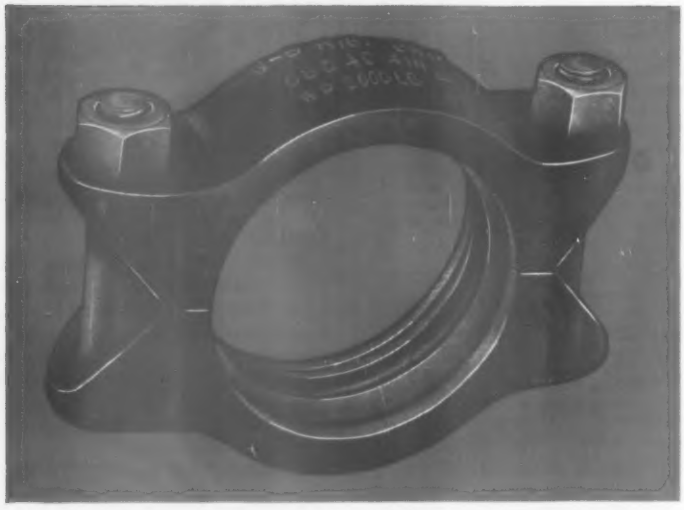

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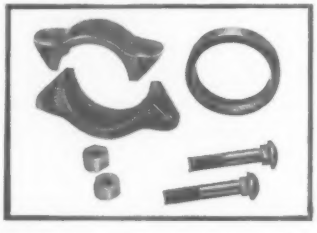


GUSTIN-BACON Manufacturing Company

210 West Tenth Street, Kansas City, Missouri

was $2.79 and for the same period of 1958 was $2.37.

I also note that Texaco's refinery runs for first 6 months of 1958 are listed incorrectly. Correct figure is 1,103,000 bbl. per day.

It is possible mistakes resulted from faulty telegraph transmission.

Thomas D. Durrance
Director of Public Relations
Texaco, Inc.

False impression made?

Dear Sir:

In summarizing my telephone conversation about the article on Texas Petroleum Research Committee (OGJ, July 13, p. 72-74), I would appreciate and so request that a statement be published in an early issue of the Journal to the effect that:

1. The research work in the University division of TPRC, which Bob Enright discussed, was not undertaken in cooperation with the Atomic Energy Commission nor does it have AEC sponsorship. 2. the TPRC research work has been concerned solely with effects of gamma irradiation regardless of source on physical and chemical properties of hydrocarbons. 3. TPRC is in no way advocating the disposal of radioactive wastes in depleted petroleum reservoirs for any purpose whatsoever, including the effect of residual oil in partially depleted oil fields.

We appreciate the continued interest of your able staff of editors in the work of TPRC and the fine publicity you have given us. We regret, however, the false impression made by the headline of this article and the implication of AEC sponsorship.

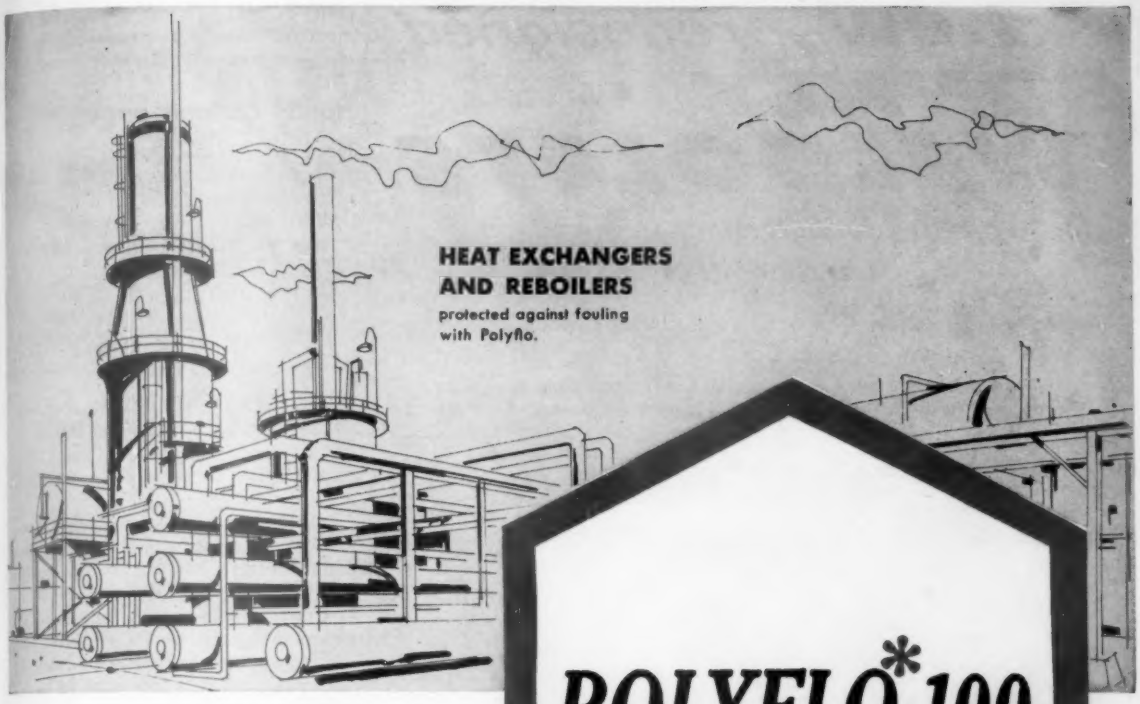
We want to assure you that we welcome any of your staff at any time and that the objective of this letter is to get the facts straight and to correct impressions that might be detrimental to both the Journal and TPRC. I know that you are just as interested in this as we are.

George H. Fancher
Texas Petroleum Research Committee

(Editor's note: The Journal regrets any erroneous assumptions stemming from the article. We did not say the project had AEC sponsorship or that TPRC advocates disposal of wastes in depleted reservoirs.

TPRC and AEC are not cooperating in the current work, but TPRC's assumption that wastes could be injected underground without danger was based on work previously done under AEC auspices.

TPRC is not using radioactive wastes in its experiments. As the Journal said, it is using Cobalt 60. This



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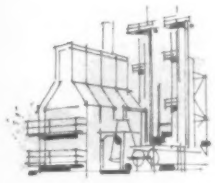

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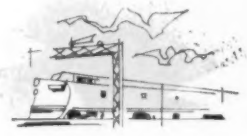

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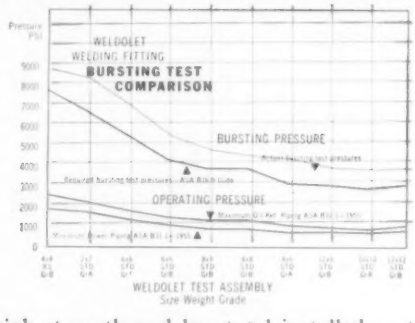

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emits gamma rays, as would the radioactive wastes which would be used if the process should prove feasible.)

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D. J. Griffin
Findlay, Ohio.

Everybody's job

"It's a great story that the oil and gas industry has to tell. But obviously the industry's story has not been well told. It's time to tell the story and tell it effectively.

"Where do people get their information? Newspapers and radio are the main sources. But this is extremely significant—among those who have had direct dealings with the industry, almost one-third credit employes of the industry as their main channel of information. Therefore, each of us is potentially an important outlet.

T. A. Steele, in an article in Hudson's Bay Oil & Gas Co.'s magazine, The Link.

Letters to They Say should be addressed to The Editor, The Oil and Gas Journal, Box 1260, Tulsa, Okla.

CALENDAR

AUGUST

26-27 Petroleum Symposium, "The Next 100 Years," University of Houston, Houston.

26-28 Pennsylvania Grade Crude Oil Association and Pennsylvania State University, twenty-first technical conference on petroleum production, Penn State campus, University Park, Pa.

27 Oil Centennial Day, Titusville, Pa.

SEPTEMBER

3-5 Northwestern International Oil Scouts Association, annual meeting, Prince of Wales Hotel, Waterton National Park, B. C.

9-11 American Society of Mechanical Engineers, American Society of Civil Engineers, West Coast conference of applied mechanics, Stanford, Calif.

9-11 Pacific Coast Gas Association, annual meeting, Ambassador Hotel, Los Angeles.

9-12 Intermountain Association of Petroleum Geologists, annual field conference, western high Uintas, registration September 9, Provo, Utah.

10-12 Magic Plains Oil Exposition, Borger, Tex.

14 American Petroleum Institute, University of Texas, seventh session of school of pipeline technology, Lee College, Baytown, Tex.

14-16 Texas Mid-Continent Oil and Gas Association, annual meeting, Rice Hotel, Houston.

15-16 American Gas Association, Southern

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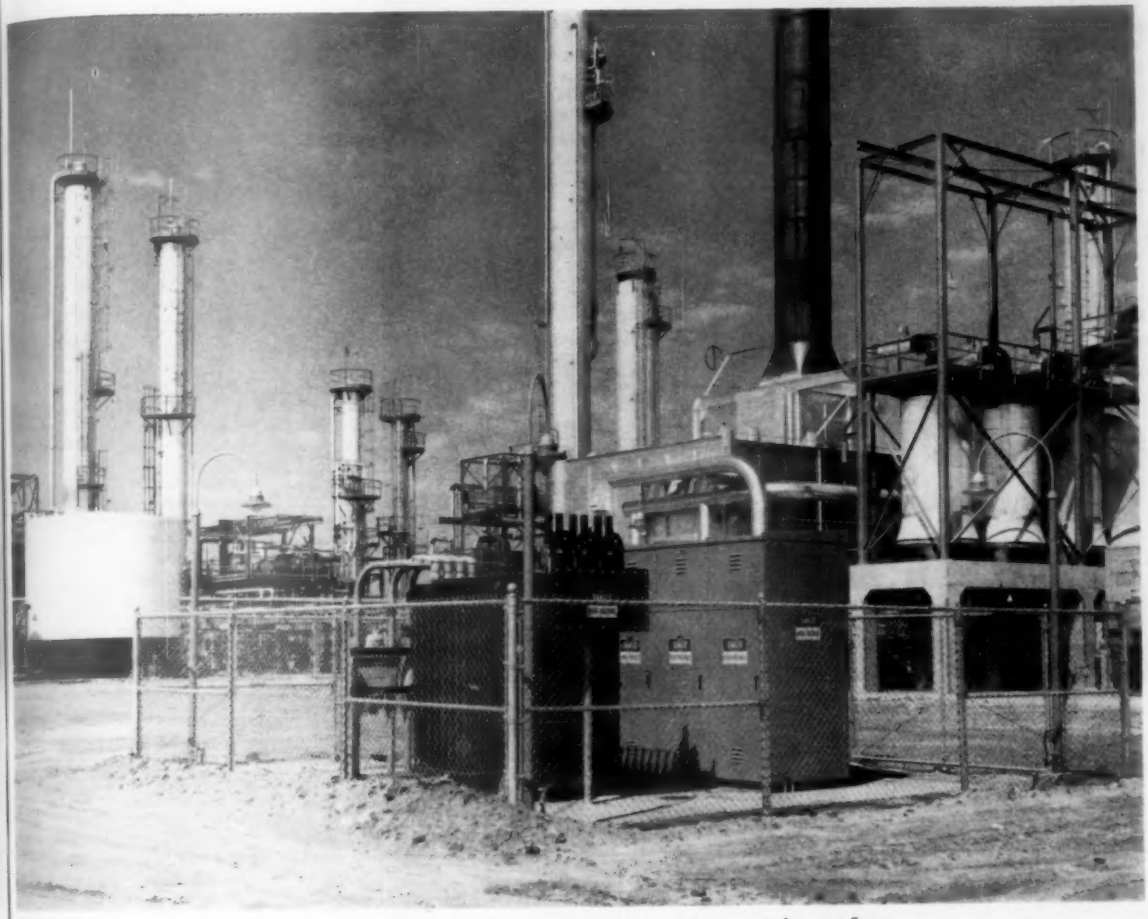
LOW MAINTENANCE



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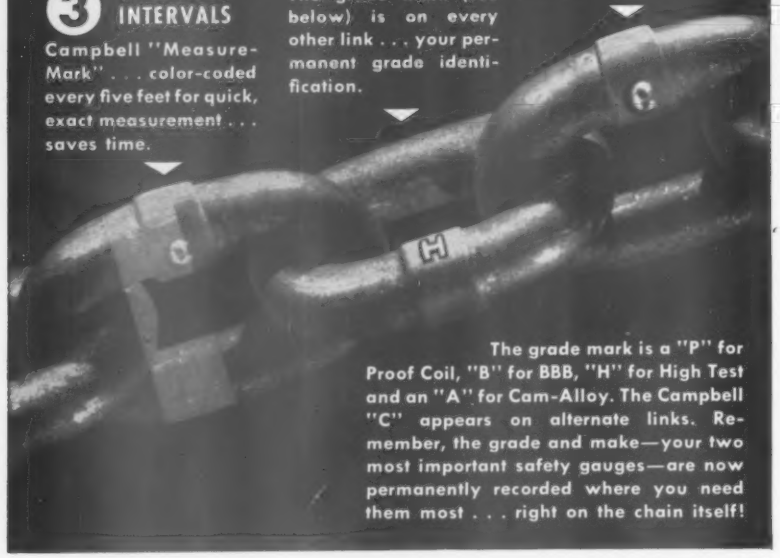

The grade mark is a "P" for Proof Coil, "B" for BBB, "H" for High Test and an "A" for Cam-Alloy. The Campbell "C" appears on alternate links. Remember, the grade and make—your two most important safety gauges—are now permanently recorded where you need them most . . . right on the chain itself!

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Made from Cam-Alloy or High Test Steel Chain with Grab Hook each end, 20 feet long. Supplied bright finish. Packed one chain in cloth bag. In dimensions and weights for every job.

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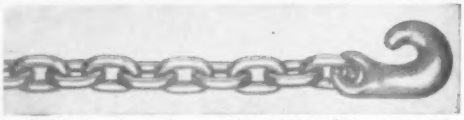

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Available in 3 grades: *Lug-Reinforced* for maximum traction and wear, *Mud-Service* for off-the-road use, *Highway Service* for general use . . . single pneumatic and dual triple.

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WEST COAST SALES MANAGER: Leonard Woods, 680 Templebar Way, Los Altos, California

TERRITORY MANAGERS: J. N. Kuhl, 7000 S. Shore Drive Hotel, Chicago, Ill.; C. W. Massey, 432 Orchid Road, Birmingham 15, Ala.; G. W. Ferree, 5634 Putnam Drive, Birmingham, Mich.; S. Adsit, 4419 W. 69th Terrace, Prairie Village 15, Kansas; A. E. Vincent, 3917 Thaxton Ave., S. E. Albuquerque, N. Mex.; K. Steinmetz, 1339 Sherwood Road, Glenview, Ill.; D. A. Ruffin, 6547 Ridgeview Circle, Dallas 30, Texas; Herman W. Froelich, 1105 S. Cordova St., Alhambra, Calif.; Peter J. Homburg, 1561 W. 111th Place, Los Angeles 47, Calif.; Morris G. Leffingwell, 244 Villa Terrace, San Mateo, Calif.; Leland M. Lenneville, 211 Oakhurst Place, Menlo Park, Calif.

CONTACT ANY OF THE CAMPBELL REPRESENTATIVES ABOVE FOR COMPLETE INFORMATION.

Gas Association, eleventh annual accident prevention conference, Dinkler Plaza Hotel, Atlanta.

16-18 Wyoming Geological Association field conference, Big Horn Basin, registration, Cody, Wyo.

16-18 National Petroleum Association, annual meeting, Traymore Hotel, Atlantic City, N. J.

17 Natural Gasoline Association of America, Rocky Mountain regional meeting, Wyoming-Gladstone Hotel, Casper, Wyo.

20-23 American Society of Mechanical Engineers, petroleum mechanical engineering conference, Rice Hotel, Houston.

21-23 Texas Society of Certified Public Accountants, sixth annual institute on taxation, Houston.

21-23 Columbia University, oil refinery workshop on passive element analog computers, Engineering Building, Columbia University, New York.

21-25 Instrument Society of America, annual instrument-automation conference and exhibit, International Amphitheater, Chicago.

22-23 National Association of Corrosion Engineers, Shreveport, La., section, eighth annual corrosion control short course, Centenary College, Shreveport.

23-24 Western Petroleum Refiners Association, Rocky Mountain regional technical-industrial relations meeting, Henning Hotel, Casper, Wyo.

24-25 Mid-Continent Oil and Gas Association, Louisiana-Arkansas division annual meeting, Roosevelt Hotel, New Orleans.

27-29 National Association of Oil Equipment Jobbers, annual convention and trade show, Hotel Leamington, Minneapolis.

27-30 American Institute of Chemical Engineers, national meeting, Hotel St. Paul, St. Paul.

29-30 Western Petroleum Refiners Association, management seminar, Western Hills, Wagoner, Okla.

28-Oct. 1 American Welding Society, fall meeting, Sheraton-Cadillac Hotel, Detroit.

29-Oct. 1 National Association of Corrosion Engineers, western region conference, Bakersfield Inn, Bakersfield, Calif.

OCTOBER

1-2 National Association of Corrosion Engineers, southeast region conference, Jacksonville, Fla.

2-3 Association of Desk and Derrick Clubs of North America, eighth annual convention, Hilton Hotel, San Antonio, Tex.

4-7 Society of Petroleum Engineers of AIME, fall meeting, Memorial Auditorium, Dallas, Tex.

5-7 American Gas Association, annual meeting, Conrad Hilton Hotel, Chicago.

5-7 National Association of Corrosion Engineers, northeast region conference, Lord Baltimore Hotel, Baltimore.

5-10 Society of Automotive Engineers, national aeronautic meeting, aircraft engineering forum, and aircraft engineering display, The Ambassador, Los Angeles.

7-8 Western Petroleum Refiners Association, fourth annual stream pollution and waste disposal conference, Broadview Hotel, Wichita.

7-10 Rocky Mountain Association of Geologists, eleventh annual field con-

ference, Saratoga Inn, Saratoga, Wyo.

8-9 California Natural Gasoline Association, annual fall meeting, Huntington-Sheraton Hotel, Pasadena, Calif.

8-10 American Association of Petroleum Geologists, Southwestern Federation of Geological Societies, second annual regional meeting, Coliseum, Lubbock, Tex.

8-10 Exploration Drilling symposium, sponsored by University of Minnesota, Colorado School of Mines, and Pennsylvania State University, University Park, Pa.

8-11 Louisiana Gulf Coast Oil Exposition, Lafayette, La.

11-13 American Association of Oilwell Drilling Contractors, annual meeting, Skirvin Hotel, Oklahoma City.

11-16 American Society for Testing Materials, Pacific area national meeting, Sheraton-Palace Hotel, San Francisco.

12-15 National Association of Corrosion Engineers, south central region conference, Cosmopolitan Hotel, Denver.

13-14 Seventh Annual Gas Measurements Institute, National Guard Armory, Liberal, Kans.

16-17 University of Texas, E. P. Schoch lecture series, process control, University of Texas, Austin.

20-22 American Standards Association, national conference on standards, Sheraton-Cadillac Hotel, Detroit.

20-22 National Association of Corrosion Engineers, north central region conference, Cleveland.

20-22 American Society of Mechanical Engineers, American Society of Lubricating Engineers, lubrication conference, Sheraton-McAlpin Hotel, New York.

22-23 American Institute of Mining, Metallurgical, and Petroleum Engineers, Los Angeles Basin section, fall meeting, Huntington Sheraton Hotel, Pasadena, Calif.

23 Natural Gasoline Association of America, southern regional meeting, Carlton Hotel, Tyler, Tex.

26-27 Independent Petroleum Association of America, annual meeting, Statler-Hilton Hotel, Dallas.

26-27 Independent Natural Gas Association of America, annual meeting, Westward Ho Hotel, Phoenix.

26-28 Society of Automotive Engineers, national transportation meeting, La Salle Hotel, Chicago.

27 American Institute of Chemical Engineers, New York section, technical symposium, Hotel New Yorker, New York.

28-29 Western Petroleum Refiners Association, annual question and answer session on refining technology, Rufus Garrett Hotel, El Dorado, Ark.

28-29 Armour Research Foundation of Illinois Institute of Technology, annual computer applications symposium, Morrison Hotel, Chicago.

28-30 Society of Automotive Engineers, fuels and lubricants meeting, La Salle Hotel, Chicago.

28-30 American Association of Petroleum Geologists, Mid-Continent regional meeting, Broadview Hotel, Wichita.

29-30 Oil Recovery Symposium on Southwest Texas, sponsored by southwest section of AIME and Texas Petroleum Research Committee, Driscoll Hotel, Corpus Christi, Tex.

NOVEMBER

4-6 Rocky Mountain Oil and Gas Association, fourteenth annual convention, Brown Palace Tower, Denver.

Quaker

How Thermoid made ground-refueling hose to meet toughest government specifications

1. Developed a tube compound that can carry all aircraft fuels without showing appreciable signs of swelling or loss of adhesion to the carcass. A tube that withstands constant bending, twisting, and flexing without ply separation. Performs well in the range −40°F to +130°F.

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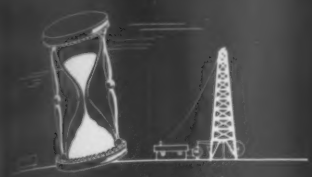

the Journal said...

50 years ago

August 20, 1909

A new record for fast drilling with cable tools is believed to have been set by Producers Drilling Co. in Morris pool, in Okmulgee County, Oklahoma, when it made 215 ft. of hole in the 8-in. during one tour.

British complain heavy inroads of cheap surplus Oklahoma and Texas crude shipped from Gulf Coast ports are crowding out Russian and Rumanian oil and flooding European markets.

Glenn Pool's big production (72,000 bbl. daily) and lack of pipeline facilities out of the state are blamed for piling up 30,000,000 bbl. of storage oil in Oklahoma and Kansas.

25 years ago

August 23, 1934

Diamond Jubilee Number (334 pages) of The Oil and Gas Journal commemorates twenty-fifth anniversary of drilling of Drake oil-discovery well.

East Texas "hot oil" situation begins to clear as railroads start refusing to accept tenders of oil not produced according to regulations of Texas Railroad Commission.

First oil production in Barber County, Kansas, is opened by Lario Oil & Gas Co. Discovery well, 1 Whalen, northeast of Medicine Lodge, and miles from other production, is state's most southwesterly producer. Pay is Mississippian at 4,350 ft.

10 years ago

August 25, 1949

Freeport Sulphur Co.'s newly completed oil-discovery well, 2-A Fee, on the Bryan salt dome near Freeport, in Brazoria County, Texas Gulf Coast, opens country's shallowest flowing production. New wildcat well in sight of Gulf of Mexico makes 55 bbl. of oil daily through 9/16-in. choke from Miocene sand at 1,360-83 ft.

Canadian Gulf Oil Co. completes second well on gigantic Pincher Creek structure in foothills of southwestern Alberta in Canada's biggest gas and condensate field and deepest production. New well, Mobil Marr, 7 miles northwest of Gulf's original Pincher Creek well, flows 83,000 cu.ft. of gas and 3,000 bbl. of 52.5°-gravity condensate daily from 12,475-ft. Mississippian horizon.

JOURNALLY SPEAKING

The Hard Hundred Years

THIS WEEK'S celebration of the oil industry's 100th birthday climaxes a months-long observance marked by speeches, articles, and books lauding oil's glorious century.

It is all very fine to tell about oil's progress, romance, and contributions to civilization. But such heady self-adulation carries a risk of smugness and complacency.

So here comes Old Iconoclast Ralph with a sour note in the midst of the gaiety. We would like to write a history of the oil business under some such title as "Dumbest Industry in the World."

We brag about oil's progress, but that progress came mighty slow, mighty slow. Oil men learned everything the hard way.

Looking back in the light of what we know now, the oil industry seems to have been incredibly stupid at every stage and on every subject. It was so slow to adopt ideas that are obvious today that it appears to have been hidebound by convention, lacking in imagination, oblivious to advances all around it, and doggedly resistant to progress.

This indictment will be more or less admitted by geologists. There are geologists alive today who were kicked off of rigs because "practical" oil men had no use for new-fangled book-learning—and also geologists who promised to drink all the oil found in certain areas that later became big producers.

The anticlinal theory was preached soon after the Drake well was drilled, but creekology and trendology were preferred for two generations. Then the pendulum swung to the other extreme and it was assumed that nothing but an anticline would form an oil trap. Every geologist in the country knew that Dad Joiner would never find oil in East Texas.

Two generations of oil men produced oil without any knowledge of how oil got to the well bores—and apparently without even any curiosity about it. Then it began to dawn on them that oil does not produce itself, but that it must be pushed by some force such as gas or water. And that in many fields these forces were naturally present and that Nature could be made to do most of the work. So gas that used to be blown off fast to get it out of the way of oil production was put back in to get more oil. It seems so obvious now but seemed so ridiculous when first suggested.

A series of accidents which at the time were considered disasters showed that letting a flood of water reach a producing zone actually yielded more oil. This was so contrary to the prevailing notion that water would ruin an oil well that serious study of the techniques of water flooding made little progress for many years after its efficacy had been demonstrated.

In East Texas, outraged public opinion backed by stern law forced producers to stop dumping salt water into creeks. At great expense, and under pressure of penalties and bonuses and amid prophecies of ruin to the field, they began injecting it into the formation. To everyone's astonishment this practice produced more oil and paid handsome dividends. This was learning the hard way.

Spindletop's gushers, drilled almost touching each other, petered out in a year or two, and everyone admitted that "the cow had been milked too hard." Yet principles of efficient spacing were not even considered for another generation and even today, nearly 60 years later, mere mention of wide spacing will start a fight among producers.

It took the first World War to show the oil industry that the motor age had arrived and that its future lay with gasoline rather than kerosine. It took the second World War to show it that the application of chemical processing could produce from oil all the products that the coal-tar industry had been making for years—and many more.

A progressive industry? Well, compared with 50 or 100 years ago, the industry's present attitude toward physical science is pretty progressive, though it had to overcome nearly a century of obstinacy to get into this frame of mind.

Look back over that century and meditate on how hard it was for oil to learn its lessons of overproduction, economics, law, public relations, marketing, business management, industry cooperation, and many other things in addition to physical science. Then ask yourself how well those lessons have been learned. It's been a hard hundred years.

—Henry D. Ralph.

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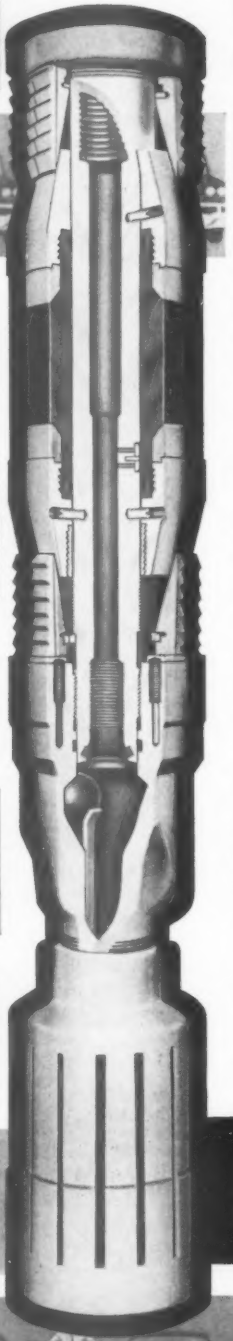

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The next 100 years in the oil industry

SHORTLY BEFORE HIS DEATH, W. L. Mellon, a founder of Gulf Oil Corp., wrote: "In the future the principal function of business, which is the creation of wealth, will be carried on with instruments devised not by artisans but by scientists."

This is a prophecy for the oil industry's next 100 years, from a man who helped shape its first 100.

Mellon probably was thinking of oil-prospecting instruments, or perhaps of refining equipment. But his prophecy applies equally to activities of business outside the realm of the physical sciences.

"INSTRUMENTS DEVISED BY ARTISANS" pretty well describes the tools with which the oil industry progressed. An artisan is a clever workman who executes another's idea or who improvises a solution with the materials at hand.

Not only mechanical devices but economic, legal, and other forms of instruments were improvised by the industry's artisans over the years. Not all the best were adopted, and some were retained long after they were outmoded, but in general the artisan's instruments served the industry well in its function of creating wealth.

A scientist, on the other hand, analyzes the basic nature of a problem, examines every possible cause and effect, relates the matter to the general body of human knowledge, and then tests his solutions skeptically before adopting one. Progress may be slower by the scientific method, but it is surer.

During the past couple of decades the industry has made great strides in using instruments devised by scientists rather than by artisans in such fields as finding, recovering, and processing oil.

It is just now beginning to grope toward a scientific approach for devising instruments for some of its other problems.

Electronic computers and psychological testing may become instruments of business management. But other types of scientific methods are needed to replace artisanship in such fields as conservation control, public relations, foreign operations, distribution, pricing, competition, and avoidance of periodic surpluses and shortages.

THIS IS THE CHALLENGE of the oil business as it enters its second century—to make a scientific approach to matters other than physical and finding better solutions than the improvisations of the past.

By its success in doing this will the public judge the worth of the oil industry in its principal function of creating wealth.

And this will also determine the survival of an individual business unit or type of organization. A new type of competition, a new sort of scientific race, faces the oil industry in its next 100 years.

FIRST IN THE WEST with a wide range of gasolines is this Hancock station in Las Vegas.

Multigrade Pump Spreads Westward

● El Paso Natural discloses it is converting throughout its marketing area to sell six grades of gasoline. Hancock goes El Paso even better and opens eight stations which dispense nine grades of motor fuel.

THE 3-year-old question: "Will anyone follow Sun Oil Co.'s pioneering venture in multigrade marketing?" was answered last week.

El Paso Natural announced it already has converted about 30 stations in Midland, Odessa, San Angelo and Snyder, Tex. It plans to extend use of the blend-at-the-pump idea throughout its sales territory.

And in southern Nevada, Hancock Oil Co. launched its multigrade program last week by opening eight stations, five of them in Las Vegas.

El Paso will custom blend six grades of its El Paso Red Flame motor fuel in its multigrade pump and will continue to sell its Dixie regular at a separate pump—a total of seven grades of gasoline.

Hancock is going the full route by using all nine combinations available on the Wayne Pump Co. pump.

El Paso's program . . . El Paso expects to install the Wayne fuel-blending pumps at all of its 400 stations by some time in 1960.

The company markets in West Texas, New Mexico, Arizona, southern Utah, and southern Colorado.

It is starting its conversion at the eastern edge of its market territory and working west. Stations in El Paso will be converted next month.

It's too early to report exact sales results, but a company spokesman says, "We've seen substantial increases at all stations.

Octane ratings will range from 89 or 90 for El Paso's Dixie regular to something over 100 for its superpremium. El Paso does not fix dealer prices, but it estimates the spread generally will range from about 30 to 38 cents.

The bold plunge into multigrade marketing is typical of the aggressiveness El Paso has shown since embarking upon an integration program 4 years ago. The move is based, the company said, on the need to match more closely the gasoline with the increasingly varied octane appetites of automobiles.

Hancock's plan . . . Hancock is now thinking it will watch its eight new stations in Nevada for 6 months or so before deciding to spread its use of the blending pump.

The company declined to reveal precise octane ratings of its various blends, but they are estimated to range from a low of 84 to 86 for regular to a superpremium high of more than 100.

The Nevada motorist will pay from 31.9 cents for Hancock 500, the lowest regular, to 36.9 cents for Hancock 550.

Las Vegas was chosen as the principal experimental area, Hancock said, because its isolated nature will make it easier to measure results of the change.

Hancock, a subsidiary of Signal Oil & Gas Co., plans to "sell down" to its customers.

It will suggest a blend to customers which is certain to run the car satisfactorily. For the next tankful, Hancock will recommend the driver try a lower octane blend—and save the difference.

Hancock's "Power Range Guide"

Car Make and Model	1954	1955	1956	1957	1958	1959
Buick–Special & Le Sabre	515	525	530	535	540	550
Others	520	535	540	540	550	550
Cadillac	520	520	540	540	550	550
Chevrolet–6	500	500	500	500	510	510
V-8	...	525	525	530	530	535
Power Pack V-8	...	...	535	540	540	550
Chrysler	515	520	530	540	550	550
DeSoto	500	500	525	540	540	550
Dodge–6	500	500	500	500	500	500
V-8	515	525	525	525	535	535
Edsel–6	...	...	...	...	...	515
V-8	...	...	...	...	550	530
Ford–6	500	515	515	520	520	520
V-8	515	525	525	535	540	535
Power Pack V-8	...	535	535	540	550	550
Imperial	...	530	540	550	550	550
Lincoln & Continental	530	530	535	550	550	550
Mercury	510	525	525	540	550	550
Oldsmobile	525	525	535	540	550	550
Packard	520	535	540	540	540	...
Plymouth–6	500	500	500	500	500	500
V-8	...	510	510	520	535	535
Power Pack V-8	...	...	535	540	550	550
Pontiac	515	515	520	535	550	550
Rambler–6	500	500	500	500	500	500
Rebel	...	...	...	510	515	515
Ambassador	...	520	535	535	540	540
Studebaker–6	500	500	500	500	500	500
V-8	500	500	510	515	515	520
Thunderbird	...	550	550	550	550	535

Its "Power Range Guide" recommendations may be a little high, Hancock admits, but it doesn't want to start out a customer on a blend that might produce knock. It would prefer he get a little extra "kick" the first time, then come down slowly to the car's most economic blend.

Similar to Sun . . . Both El Paso and Hancock use the system of two storage tanks adopted by Sun. The motorist selects his fuel and the station attendant dials the selection.

Streams from both storage tanks are blended at the hoze nozzle. This feature prevents contamination of blends when a switch is made. According to a Wayne Pump official, only about a teaspoon of blend is mixed with another blend when changes are made.

The background . . . The Hancock and El Paso use of the blending pump is the first in the United States since Sun first experimented with it in Florida early in 1956.

Imperial Oil Ltd., put the pumps into experimental use in four stations in Toronto a little over a year ago (OGJ Newsletter, Aug. 4, 1958). And British Petroleum Co. recently inaugurated multigrade marketing in Germany because of the wide range of octane requirements there (OGJ, June 8, p. 131).

Sun's move, first with five grades and later with six, was a surprise to the industry. Before that it had stuck to a single grade of gasoline.

It began its program with a 17-station experiment in February of 1956 at Orlando, Fla., (OGJ, Feb. 27, '56, p. 82). In May it expanded the program to cover all of Florida, and 3 months later it decided to extend the operation into Georgia.

Early in 1957 Sun ordered 10,000 pumps and announced it was planning to convert its entire 21-state marketing setup from single to many-grade marketing. By October the first pumps had been installed in the East—at Rosemont, Pa.,—and in 1958 the entire conversion program was completed.

What happens next, no one knows. On the West Coast last week there was a rumor a major-company marketer was considering the multigrade approach. There also was speculation that Hancock might not wait 6 months before expanding its program.

But one thing was certain. Sun was no longer alone in its method of selling gasoline.

U. S. Gasoline Tax May Hit 4 Cents Next Week

QUICK congressional action is expected this week on a proposed increase of 1 cent per gallon in the federal gasoline tax.

The additional levy, as approved by the House ways and means committee, would go into effect next week (September 1) if it clears both houses of Congress and is approved by the president before that date.

Action on the tax measure was held up for several days last week during the absence of Rep. Charles A. Buckley (D-N. Y.). Buckley is chairman of the House public-works committee, which previously had approved more highway construction than the 1-cent tax would finance.

The proposed tax increase, together with other revenue already going into the highway trust fund, would allow apportionment this year of about $1.8 billion as the federal share toward building the interstate highway system. This figure compares with authorizations of $2.5 billion approved by the public works committee.

Provisions . . . Under the Ways and Means plan, gasoline taxes would be increased from the present 3 cents a gallon to 4 cents for a 22-month period ending June 30, 1961.

After that, the plan calls for earmarking more existing road-user taxes for use in the highway-construction program. During the 3-year period ending June 30, 1964, half of the revenue from the 10% automobile excise tax and five-eighths of the 8% tax on automobile parts and accessories would be transferred from the general fund to the highway trust fund.

Oil jobbers won a concession from the ways and means committee to help offset the effects of the proposed tax increase.

The committee approved their long-sought plan to transfer collection of the gasoline tax from the refinery to the jobber level. Under this proposal, jobbers would be responsible for the tax only on gasoline they sell and would not have to pay taxes on volumes wasted through spillage or evaporation.

Discovery Made Just South of Arctic Circle

• Canadian company finds gas and oil in second try in Yukon territory.

THE GROWING search for oil in the Far North turned up a significant discovery last week.

Western Minerals 1 Chance in north-central Yukon territory had oil and gas shows from 4,250 to 4,415 in the Permo-Pennsylvanian. Tests in a 140-ft. pay zone yielded 10,000 M.c.f. of gas daily and a light gravity oil. Cores were flown to Calgary by helicopter for analysis.

The discovery, first in Yukon territory, is just south of the Arctic Circle. It was drilled by Conwest Explorations, whose parent company is Western Minerals, Ltd., Calgary.

The area is relatively unexplored and remote. Equipment must be brought in by tractor train through the Yukon mountains and drilling is limited to a short summer period. Moving possible production to market would pose a problem. The discovery is about 450 miles from the Pacific Ocean and 320 miles northwest of the Norman Wells field.

This is the first discovery in the northlands since the Norman Wells field was found in 1920 in Northwest Territories.

The well was drilled on acreage acquired in a farmout agreement from Peel Plateau Exploration Consolidated, Ltd. The farmout tracts are in the Eagle Ridge Plains area and cover 13,417 sq. miles or nearly 8,000,000 acres. (OGJ, Mar. 31, 1958, p. 58).

Early well dry . . . The big exploration push in this area, straddling the Arctic circle, began 3 years ago, with Imperial Oil Ltd., Peel Plateau Exploration, Ltd., and Canadian Husky Oil, Ltd., making preliminary surveys.

Nine companies applied last year for tracts totaling 13,000,000 acres from Canada's Department of Northern Affairs. The companies included Standard Oil Co. of California, British American Oil Co., Ltd., Shell Oil Co. of Canada, Ltd., Placid Oil Co., Hunt Oil Co., Pan American Petroleum Corp., Texaco Exploration Co., Ohio Oil Co., and Charter Oil Co., Ltd. and associates. (OGJ, April 21, '58, p. 98).

Canadian officials say there now are 12 exploratory crews working in far north provinces, "the biggest concentration of men and machines ever organized to investigate oil and gas possibilities in the northlands."

First well by Western Minerals was drilled on the Peel plateau, about 100 miles southeast of the discovery. It was dry. Drilling in Yukon is done on federal permit. Permits have been issued or applications for exploration have been made on more than 170,000,000 acres.

Alberta-to-Frisco Gas Line Hearing Near

ONE OF THE BIGGEST gas-pipeline projects ever planned will go before the Federal Power Commission for hearings starting October 15.

It's the 1,400-mile $330-million system which would transport gas from Alberta to San Francisco. The 36-in. system involves several companies.

Alberta Gas Trunk Line Co., Ltd., will apply September 15 to the Alberta Oil and Gas Conservation Board for the right to construct a 336-mile $97-million line. It will run from the Berland River area of northwestern Alberta to the Crow's Nest Pass and the Alberta-British Columbia Border.

The line will carry gas from fields in which Westcoast Transmission Co., Ltd., and Alberta & Southern Gas Co., Ltd., have contracts with producers. It will tie in with a 107-mile $40-million line to be constructed by Alberta Natural Gas Co., which is owned by Westcoast and Alberta & Southern. Alberta & Southern is a subsidiary of Pacific Gas & Electric Co.

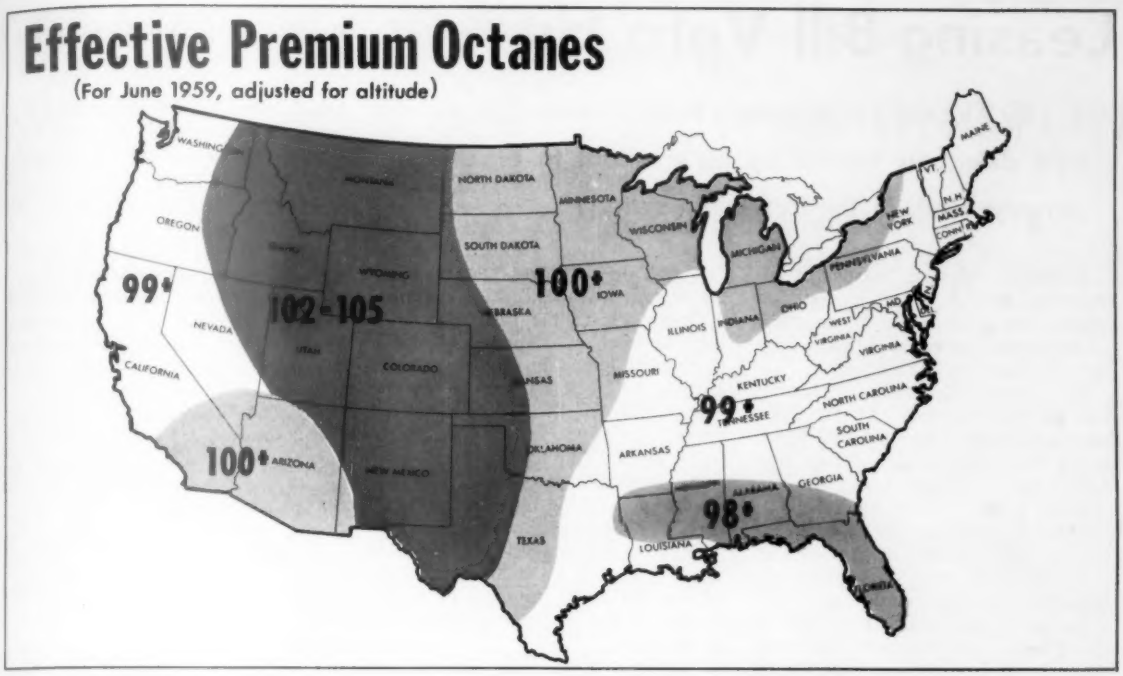
Alberta Natural will build the section from the Alberta-B. C. border to the B. C.-United States border near Kingsgate, B. C. Pacific Gas Transmission Co., owned by PG&E, proposes in the FPC application to build 614 miles of 36-in. from Kingsgate to the Oregon-California border near Klamath Falls, Ore.

From this point PG&E will extend the 36-in. for 296 miles to San Francisco.

Gas export approved . . . The Alberta Government has approved the export of 3.1 trillion cubic feet of gas to the United States, 2.3 trillion by Alberta & Southern at the rate of 400,000 M.c.f. daily and 800 billion cubic feet by Westcoast at the rate of 165,000 M.c.f. daily (OGJ, Oct. 20, 1958, p. 48).

The Westcoast gas is to be delivered to Pacific Northwest Pipeline Corp. near Spokane, Wash. Pacific Northwest plans new facilities costing about $2,314,000, including 17 miles of lateral lines plus a metering and regulating station.

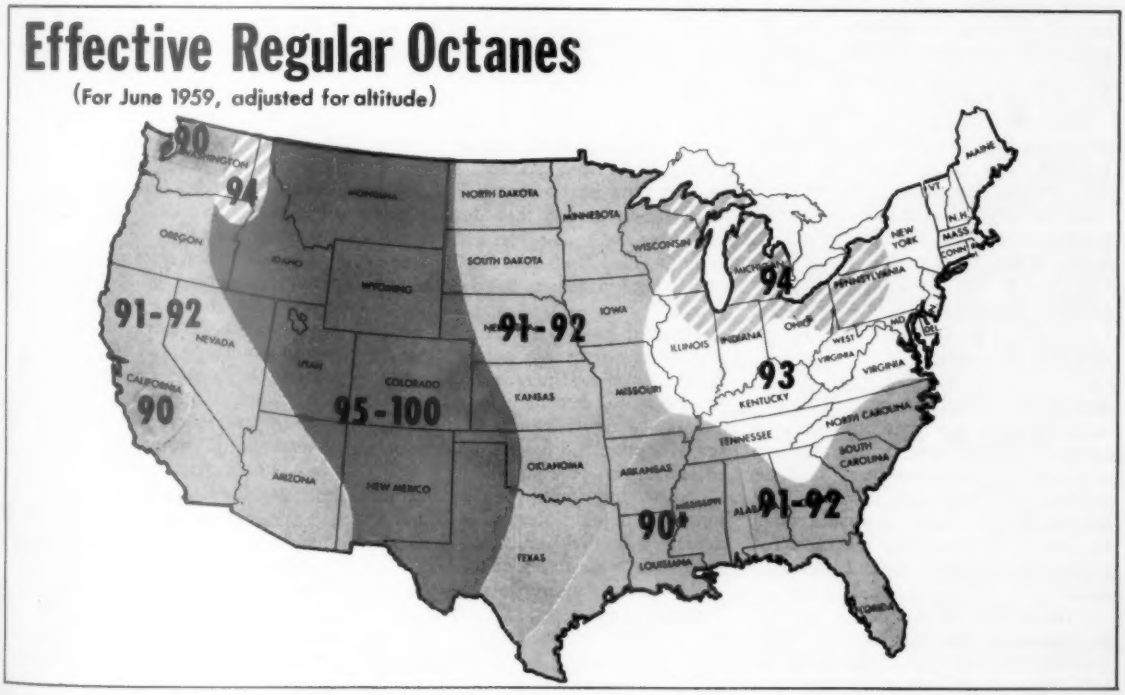
Pacific Northwest also proposes to sell up to 150,000 M.c.f. gas daily to El Paso Natural Gas Co., near Ignacio, Colo.



Rockies Tops in Effective Octanes

MOTORISTS in the Rocky Mountain region are getting their money's worth in gasoline—although it doesn't measure up to the rest of the nation in research octane numbers.

But reported research octanes are "sea-level" octanes. They don't take into consideration altitude, which lowers a car's octane requirements. So when the octanes are adjusted to altitude, the Rockies come out with what is termed the highest "effective" octane ratings in the country. For instance, sea-level octanes of regular-grade gasoline sold in Denver and Salt Lake City are below 90. But Denver's 5,280-ft. altitude and Salt Lake City's 4,390-ft. altitude have the effect of adding about 10 octane numbers to the gasoline.



Leasing-Bill Veto Hit

. . . by Alaska's congressmen. Feud between Seaton and new delegates fanned by Ike's refusal to expand the acreage limits in the forty-ninth state.

FORMER Alaskan "wards" of Interior Sec. Fred A. Seaton have turned against him with renewed vengeance for his opposition to the Alaskan leasing bill vetoed by the President.

Sen. Ernest Gruening (D-Alaska) said he was "shocked" by the President's action in killing the bill, which would have doubled the acreage limitation on oil and gas leases and options on federal land in Alaska.

"The President's veto can be explained only by the assumption that it was strongly recommended by the Department of the Interior," he said.

Gruening and fellow members of the Alaska congressional delegation (Sen. E. L. Bartlett and Rep. Ralph J. Rivers) joined in blasting what they termed "specious reasoning" in opposition to the bill. This was in reference to the argument that increasing the acreage limit would have the effect of reducing Alaska's future revenue unless Congress raised the minimum rental on public lands.

They pointed out the Secretary of the Interior already had the authority to raise rentals. The Democratic trio urged the President, if he was genuinely concerned about the possible loss of revenue, to approve the bill and at the same time "request" Seaton to "make use of the authority he now has to raise such rentals."

Gruening charged in a separate statement that the Department of the Interior "has not grasped the fact" that Alaska has achieved statehood "and no longer is a ward" of the department. During the preceding 75 years, when Alaska was a territory, "the fiat of the Secretary of the Interior determined the fate of Alaskans—often, as now, to their disadvantage," he said.

The bill . . . The vetoed bill would have doubled the present combined limit of 300,000 acres which any one company or individual may hold in mineral leases and options on federal land in the new state. It was intended to provide the necessary incentive for large-scale exploration and development.

"Those who know Alaska are better informed than the bureaucrats in the Department of the Interior whose testimony at the hearings indicated they had no first-hand knowledge of the regions involved," said Gruening.

Opposition to the bill came as a surprise when 30 Republicans and 2 Democrats joined in an unsuccessful attempt to block its passage by the Senate. Earlier, the bill had breezed through the House by voice vote after being amended in committee.

As originally introduced, the bill would have set the limit at 1,000,000 acres. This provision was opposed by Interior, which suggested a 600,000-acre limit, with a 300,000-acre limit on the north and south sides of the Brooks Range in the northern part of the state.

Congress made only one major change in the Interior version. It did away with the regional limitations so a company or individual could hold the full acreage allowable anywhere in the state.

Veto message . . . In his veto message President Eisenhower expressed the view that "unrestricted doubling" of the acreage limit would not be in the best interests of Alaska or the Federal Government.

"Rather than providing an inducement to the development of oil and gas resources in Alaska," he stated, "the bill would tend to produce an excessive concentration of control over such potential resources, and there is no assurance provided by the bill that the interests so held would at any time be developed."

Eisenhower said that development contracts and unit agreements already provide relief from acreage limitations "when circumstances justify their approval."

He said he was aware that allowing increased acreage holdings "might be of immediate financial importance" to the state, but he warned that it eventually could result in depriving both the state and federal governments of substantial revenue.

"Sacrificing sound principle and the long-run public interest in order to achieve a limited immediate gain does not seem to me to be wise."

At a press conference preceding the President's veto, Sec. Seaton declined to say what recommendation—if any—he would make on the fate of the bill. But he spoke at length on his reasons for opposing it—reasons reflected later in the President's veto message.

Other issues . . . There were indications on Capitol Hill that the President's veto may have far-reaching repercussions, even for oil operators who have no intention to join the search in Alaska.

According to one line of thinking, the veto just about wiped out all hope of getting other lease reform bills through Congress this session, with the possible exception of the measure to protect innocent parties from cancellation proceedings.

This bill, by Sen. Joseph C. O'Mahoney (D-Wyo.), was approved by the Senate interior committee last week after other, more controversial, provisions were stricken.

But regardless of the effect on the oil industry, the veto was a significant victory for Seaton in his running controversy with the Alaskan delegation.

The squabble dates back at least to Alaska's 1958 congressional campaign. Seaton roamed the state-to-be, urging Alaskans to elect Republicans to Congress. They responded by electing a full contingent of Democrats.

Expansion Slated

. . . at McMahon plant near Fort St. John in B.C.

A $3-MILLION expansion is in the works for the McMahon gas-processing plant at Taylor, B. C.

Stearns-Roger Engineering Co., Calgary, has been awarded engineering and construction contract for expansion of the plant, located 10 miles south of Fort St. John and owned by Phillips Petroleum Co. and Pacific Petroleums, Ltd.

The expansion program, with completion scheduled in 1960, will make a complete refinery operation at the big complex. The plant already has gasoline-blending facilities, hydrogen-treating unit, and catalytic reformer. The plant currently processes 300,000,000 cu. ft. of gas daily and has a total liquid output of 3,000 bbl. daily. Production includes LPG, natural gasoline, and some motor fuel.

Expansion of the gas plant will include a butane splitter column and a deisopentanizing column.

The construction program includes a 2,000-bbl. crude unit, a 700-bbl. alkylation unit, a 1,300-bbl. fluid catalytic cracking unit, and storage facilities.

Lease Sale in Mill

. . . by federal Government on Gulf of Mexico areas.

THE BUREAU of Land Management is preparing for another sale of oil and gas leases off Texas and Louisiana in the Gulf of Mexico.

Nominations have been invited to help determine areas to be offered for lease. Deadline for submitting nominations is September 25. Date of the proposed lease sale has not been set.

Areas eligible for nominations include unleased blocks on the outer Continental Shelf off Texas and in zones 3 and 4 off Louisiana's coast. Zone 3 extends from the 3-league line off Louisiana seaward to the disputed state limits as defined by Louisiana law in 1954. Zone 4 extends seaward from the belt claimed by Louisiana.

Zone 3 receipts are to be placed in escrow pending settlement of the boundary dispute before the Supreme Court. Any receipts from Zone 4 leasing are to go into the federal treasury.

Nominations should be addressed to the Director, Bureau of Land Management, Washington 25, D. C., and copies should be sent to the Regional Oil and Gas Supervisor, Geological Survey, Gulf Coast Region, 204 Maritime Building, 203 Cardondelet St., New Orleans 12, La. Envelopes should be marked "nominations for leasing in the outer Continental Shelf."

A joint lease sale by the State of Louisiana and the federal Government earlier this month brought in a total of $88,035,121 for 38,820 acres in Zone 2 off Louisiana (OGJ, Aug. 17, p. 91).

Calco to Drill Off Florida

THE FIRST well off the northwest Florida coast in the Gulf of Mexico will be started within 30 days under an agreement between Coastal Caribbean Oils, Inc., and The California Co.

In addition to the well to be drilled by Calco, the agreement provides for exploration of 4,000,000 acres of Florida offshore leases held by Coastal Petroleum Co., a Coastal Caribbean subsidiary, and a limited drilling program by Coastal Caribbean on 500,000 acres in the Lake Okeechobee area.

The Florida offshore well will be 1½ miles off the coast of Franklin County. Projected to 7,000 ft., it will be drilled from a submersible barge. The target is the Tuscaloosa sands, which are productive in nearby Alabama and Mississippi.

watching WASHINGTON

Joe Reilly

• Hussey is no "me-too" FPC commissioner . . .

JOHN B. HUSSEY, newest member of the Federal Power Commission, seems destined to become the great dissenter in FPC price rulings.

The former Louisiana conservation commissioner has been a member of the FPC since June 1958. During his first few months in office he raised a dissenting voice from time to time against routine orders suspending rate increases proposed by independent gas producers. His opposition, though apparently futile, was true to the tradition of his predecessor, the late Seaborn L. Digby.

Hussey's dissenting voice was stilled temporarily last December when he suffered a heart attack which laid him up for a couple of months. Though still under doctor's orders to take it easy, Hussey refuses to be a "me-too" commissioner. He has given notice that he plans a vigorous role in formulating the policy under which the commission will control producer rates.

Hussey

Two departures from present policy were advocated by Hussey in rate cases recently decided by the FPC. In each case he argued—refreshingly, though unsuccessfully—in favor of a better break for the producer.

In the El Paso Natural Gas rate case, the majority held that the company was entitled to the advantages of the depletion allowance and expensing of intangible drilling costs in figuring net income from its producing properties. The tax incentives, according to the majority's reasoning, would give El Paso a return of 8.61% on these properties. That was held to be plenty.

It was Hussey who pointed out that this principle (though a major concession) allowed El Paso no return on its investment in producing properties other than the incentives provided by law. In his dissenting opinion, he said:

"No one goes into business merely to accomplish a tax saving. An investor seeks security of his capital and a return on his investment. If the business is inordinately hazardous, the investor would expect additional return to compensate for the risk of losing his capital."

Statutory tax incentives, he concluded, are intended as "additional return," not the full return. For the test period involved, he said, El Paso's depletion calculated on percentage of income was less than its depletion calculated on percentage of cost. In other words, El Paso apparently could have made more money without the depletion allowance.

In the Transwestern Pipeline case Hussey proposed a depth-bracket formula for setting the wellhead price of gas. This proposal, which would allow higher rates for deep production, is modeled after the oil-proration formula which he formerly enforced in Louisiana.

He proposed a price differential for shallow, intermediate, and deep gas. A higher price for deep gas, he thinks, would "encourage the search for and development of deeper gas reservoirs, without affecting the lower price paid for gas produced from the shallower (and hence less expensive) reservoirs."

Hussey said the commission "might have been persuaded to allow higher prices for gas produced from deeper reservoirs" if sufficient evidence had been presented in the Transwestern case.

This seems to indicate that Hussey at least has some other commissioners listening to him.

TWO WELLS are being drilled with cable tools at Titusville as part of the festivities as . . .

Oil Holds 100th Birthday Party

THE NATION'S celebration of the 100th birthday of the oil industry reaches a climax this Thursday in Titusville, Pa.

In honor of the first oil well drilled there on August 27, 1859, Titusville has invited the world to participate in:

. . . **Dave Garroway's** 2-hour "Today" show over NBC-TV originating live from Titusville. It will feature the final episode describing drilling of "Big Dave No. 1" near Enid, Okla., and "shooting" of the newly-finished well in Drake Park.

. . . **Presenting early model** tank car to the Drake Museum by Union Tank Car Co.

. . . **First sale** of oil-industry commemorative stamp at Titusville post office.

. . . **Centennial addresses** by Pennsylvania Gov. David L. Lawrence and Gen. Ernest O. Thompson, chairman of the Texas Railroad Commission.

. . . **Burial of a time capsule** containing mementos of the present day oil industry.

. . . **Presenting** posthumous commission as colonel in the Pennsylvania National Guard to Edwin L. Drake. Drake started the oil industry by drilling the first oil producer. His granddaughters will receive the commission.

. . . **Late evening barbecue** at the Titusville Country Club.

A busy week . . . The Thursday addresses by Gov. Lawrence and Gen. Thompson are the highlights of a busy week in Titusville.

The program started Sunday with homecoming services at city churches and a concert by the Chautauqua Symphony Orchestra. The Oil Ameri-

100 Years of Oil

1859—Drilling of first commercial oil well in the United States was completed at 69½ ft. by Edwin L. Drake near Titusville, Pa., on August 27.

1865—Samuel Van Syckel proved the feasibility of piping crude oil with a 5-mile, 2-in. screwed-joint, wrought-iron line from Pithole City, Pa., to the railhead at Miller Farm.

1866—A patent for a method of increasing production of oil by exploding torpedoes at the bottom of wells was granted to E. A. L. Roberts.

1879—George B. Selden applied for a patent on an automobile driven by an internal-combustion engine.

1900—First automobile show was held in New York, November 3-10.

1901—The Lucas gusher, the largest well yet discovered, came in at Spindletop, Texas.

1903—Wright Brothers made the first successful flight in a heavier-than-air craft, at Kitty Hawk, N. C., December 17.

1913—A patent was issued to William M. Burton for the first basic cracking process.

1923—Leaded antiknock gasoline was sold for the first time in Dayton, Ohio.

1925—First diesel-electric locomotive bought by an

OIL'S HISTORY is captured in the many models of early-day equipment on display at the Drake Memorial Museum. Checking one of the models are Ned H. Dearborn, left, president of Oil Centennial, Inc., and A. C. Thompson, curator of the museum.

FIRST DRY HOLE is the site of a marker at Tidioute, Pa. Ed Lutz, 100-year-old retired oil man, dedicated the marker "to all the men who tried and failed in their search for oil." Helping unveil the marker is J. Paul Jones, chairman of Oil Centennial.

cana exhibit opened Monday and the first of a series of daily performances of a "100 Years Ago" pageant started.

An outdoor concert by a 100-voice chorus was added to the program for Tuesday, and Wednesday's activities will feature the second century conclave of oil. Panelists are Capt. Matthew V. Carson, Jr., director of the Office of Oil and Gas; Arthur C. Butler, director of National Highway Users Conference; John Sloan Dickey, president of Dartmouth College; and Leslie Barnes, president of Allegheny Airlines.

A program of athletic events and dancing Friday and a colorful parade Saturday will conclude the celebration.

One feature of the celebration is drilling of two wells in Drake Memorial Park near the site of the famous Drake well. The first was spudded with cable tools on August 10 and the

Anniversary Issue to Be Sealed in Capsule

A COPY of Petroleum Panorama, the Journal's 100th anniversary issue, is scheduled to be buried this week in Titusville in a time capsule with other mementos of this period in the oil industry's evolution.

Petroleum Panorama, a comprehensive analysis of the progress during the first 100 years of oil's history, was published in January after 2 years of research and preparation by the Journal staff. A few copies still are available at $2.50 each.

American railroad began switching service in New York, October 20.

1927—Charles Lindbergh flew from New York to Paris, May 20-21.

1930—East Texas field, which is expected to produce 5 billion barrels of oil, is discovered.

1932—Federal tax on gasoline—1 cent per gallon—and on lubricating oil—4 cents per gallon—went into effect June 21.

1938—First oil discovered offshore at Creole field, 1 mile off Louisiana. Superior Oil Co. was operator in joint operation with Pure Oil Co.

1941—The fluid catalytic cracking process first went into operation.

1942—Crude oil was turned into the Big Inch war emergency pipeline running from Longview, Tex., to Norris City, Ill. The line later was extended to New York.

1951—U. S. portion of the Williston Basin opened with discovery of Beaver Lodge field.

1956—Egypt seized the Suez Canal, July 26. U. S. oil companies organized an "oil lift" that prevented European fuel shortages.

1957—A jet plane crossed U. S. in 3 hours, 23 minutes.

second was spudded a few days later.

Samples of each run from Centennial Well No. 2 are being placed in a glass rod and will be exhibited later at the Drake Museum.

What it's about . . . The Titusville hoop-de-do celebrates the achievement of a former railroad conductor.

Drake was sent to Titusville by a New England company founded with the aim of producing petroleum. Drake drilled the first commercial oil well in history, finding oil at a depth of 69½ ft.

Within a few years of Drake's discovery, millions of people in the U. S. and abroad were lighting their homes with kerosine refined from crude oil produced in the booming Western Pennsylvania oil fields.

As the expanding young industry found new producing fields, laid pipelines, and built refineries, oil products became essential ingredients in the rapid industrial growth of the late nineteenth and twentieth centuries.

But just to prove that oil men are realistic and know the gamble in their business, earlier this month a marker also was erected near Titusville commemorating the first dry hole.

The marker noted that 4 days after Drake completed his producer J. L. Grandin "kicked down" a well with a spring pole on his farm just outside Tidioute. It proved dry—the first of many others in the industry—but also the well was the first to have the tools stuck and to have an explosive charge set off in it in an attempt to gain or increase production.

California Gas Search Booms

THE HIGH prices and ready market for natural gas in population-booming California is spurring drilling activity, particularly in the Sacramento Valley.

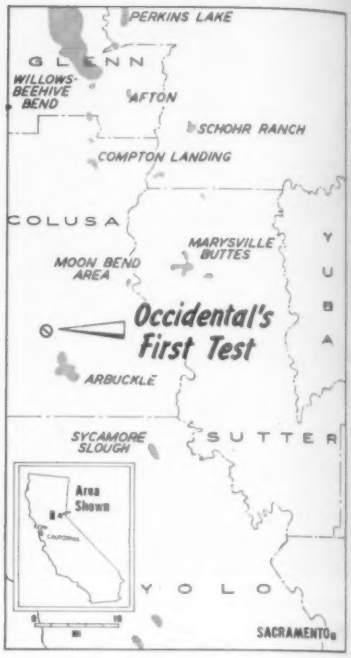
The growing interest in California's natural-gas regions was pointed up by the recent acquisition by Occidental Petroleum Corp. of a half interest in 34,000 acres in Colusa County from Western Gulf Oil Co. The acreage surrounds the Arbuckle gas field about 50 miles northwest of Sacramento.

Occidental immediately launched a 10-well drilling program by spudding in its first well 3½ miles northwest of the nearest Arbuckle field producer. Surface pipe has been run to approximately 1,750 ft., and drilling is proceeding toward the projected depth of 6,600 ft.

The company estimates its share of the 34,000 acres has a reserve of 700,000,000 M.c.f. Occidental places an $80-million value on the holdings, allowing for a success ratio of 50%.

Farmouts . . . The Occidental-Western Gulf deal follows the current trend of major companies making farmout deals with independents and individuals in the gas provinces. More than half the state's gas drilling is being carried out by small companies or individuals.

The Sacramento Valley is experiencing its biggest gas search in years.



Of 18 rigs working, eight are drilling wildcats. No one section is dominating the play, which is divided among 10 counties. The Vernalis-Tracy region of San Joaquin County and the River Island gas field in Sacramento Valley each has four tests under way or about to start.

PIPELINE BRIEFS . . .

Contract to lay 100 miles of small-diameter gathering and trunk line for Mid-Continent Pipe Line has been awarded to two firms. Jess Whitlow, Ponca City, Okla., will lay gathering lines in Alfalfa and Grant counties, Oklahoma, and A. C. Holder Construction Co., Tulsa, will lay 36 miles of 6-in. main line, to be completed in November.

Contract for 19 miles of 24-in. for Southern Natural has been awarded to C. S. Lenoir Construction Co. The project is in the vicinity of Enterprise, Miss. Construction began last week.

An expansion of the Jayhawk Pipeline Corp. crude line in Kansas is being made by construction of booster stations at Harper's Ranch, Clark County, and Haviland, Kiowa County. Shamrock Contractors, Inc., Dodge City, Kans., has the contract. Harper's Ranch will be a combination injection and booster station, receiving crude from Oklahoma through the new Wheat Belt Pipe Line. Haviland station will be unattended.

The first satellite compressor station on the Cities Service Gas system will be operating this fall. The new Sublette, Kans., station, with one gas-engine compressor, will be controlled from the Hugoton station 13 miles away.

A 27-mile 20-in. supply line in South Louisiana has been contracted to Houston Contracting Co. The line will be built for United Gas Pipe Line.

Some 40 miles of 3 to 10-in. gathering line is being laid by Pembina Pipe Line in Pembina field, Alberta. Mannix Co., Ltd., the contractor, is scheduled to complete the project by the winter freeze-up. Mannix also is laying 40 miles of 4 to 10-in. for Federated Pipe Line in Virginia Hills, Judy Creek, and Sara Lake oil fields, to be completed by the end of September.

Improved products distribution will result from the construction of a 101-mile 8-in. line from Wayne to Flint and Owosso, Mich., by Buckeye Pipe Line. Sun Pipe Line will lay an 8-in. connection from its Toledo-River Rouge, Mich. line to the new Buckeye line and build a $575,000 bulk terminal at Owosso. This will give Sun direct pipeline service for central and northern Michigan from its Toledo refinery. The present distribution system involves trucking from River Rouge to the Flint, Grand Rapids, and Jackson, Mich., areas.

New Scout Plan Nearly Ready

. . . to begin operation in West Texas and New Mexico.

Only four more firms needed to start system January 1.

A NEW COMMERCIAL scouting service, covering West Texas and eastern New Mexico, may be in operation late this year.

Sixteen oil companies, of a minimum 20 needed to inaugurate the system, have agreed to buy the West Texas service at $950 monthly.

Fifteen companies have signed for the eastern New Mexico service at $500 a month. While this is sufficient to begin this service, operators plan to wait until West Texas is ready and kick them off simultaneously.

The Williams & Lee Scouting Service, not yet incorporated, is completing organizational work. Owners are Lynn K. Lee, Fort Worth geologist and former exploration manager for Pure Oil Co., and C. B. Williams, Fort Worth, formerly a West Texas division manager for Texaco, Inc.

Two checks now meet weekly in Midland, one the West Texas Well Scouts and the other the West Texas Pipeline Scouts. The eastern New Mexico check meets in Roswell. The Midland checks, among the largest in scouting, have attendance up to 110.

Second setup . . . "We expect to get the necessary 20 for the West Texas service soon," Lee said last week.

"We can be in operation within 90 days. Our target date now is January 1. That would give us 30 days or so for a dry run on the operation." Lee said his organization will offer full-scale scouting information to subscribing companies.

The first commercial scouting service, to serve Rocky Mountain states, will begin operation October 1 (OGJ, Aug. 3, p. 44). Well Record Service, an affiliate of Petroleum Information, Denver, is beginning the service for seven charter companies, handling data in North and South Dakota, Wyoming, Montana, Colorado, Utah and western Nebraska. Monthly fee is $2,500 per company.

The seven participating companies have voted to withdraw their scouts from scout checks in these states after October.

Of the six Rocky Mountain checks, the Durango, Colo., and Bismarck, N. D., meets will be most seriously affected. Possible maximum attendance might be cut to three or four scouts, making meetings impractical. Other checks at Denver, Casper, Billings, and Salt Lake City will be weakened in varying degrees.

What's involved . . . The Midland subscribers would receive weekly set scout tickets on all drilling and completed wells, tabulated first reports, tabulated completion reports, and tabulated weekly wildcat reports.

These would be delivered Tuesday, Thursday and Friday of each week. New Mexico subscribers would receive the same type of information, delivered Monday and Wednesday.

There would be an additional charge for daily well reports to meet special requirements, the fee not yet fixed, and additional charges for extra copies of the basic reports.

Fees for all subscribers will be reduced if the number exceeds the required minimum, Lee said.

Tennessee Gas May Expand

TENNESSEE Gas Transmission Co. may add another company to its growing family.

The board of directors of East Tennessee Gas Co., Knoxville, has approved a plan whereby Tennessee Gas will acquire all outstanding East Tennessee common stock through a stock exchange.

East Tennessee operates 727 miles of pipelines ranging in size from 2 to 22 in.

Tennessee Gas offered to exchange one share of its stock for each two and three-fourths shares of East Tennessee stock, provided that 80% of the East Tennessee holders approve.

Tennessee Gas will file shortly with the Securities and Exchange Commission a registration statement covering an offer of the additional common shares needed for the acquisition.

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and barge shipments during the navigation season from Toledo to Bay City on the St. Clair River.

Permian Basin Pipeline Co. has completed a new 62-mile 16-in. lateral to take gas from the prolific Emperor Devonian and Ellenberger fields of Winkler County, West Texas, to a connection at its main line near Hobbs, N. M. The line has a current capacity of 30,000,000 cu. ft. daily. It is expected to be moving that much by September 1. Its capacity can be enlarged considerably on short notice. The Emperor field outlet is one of the longest gas pipelines to be coated internally in place with plastic.

Construction has started on a 14.4-mile natural-gas line from Moreno to Perris in Riverside County, Calif. Southern Counties Gas Co. is building the line to supply additional gas to the San Diego Gas & Electric Co. When completed, this $1.2-million dollar project will finish the looping of the existing 35-mile 24-in. line in the area. The new line will have a capacity of 142 million cubic feet daily. Engineers Pipeline Co. has the contract. Completion is expected before November 1.

Some 106 miles of 4, 6, and 8-in. will be laid by Western Slope Gas Co. in the vicinity of Grand Junction, Colo. Contract has been awarded to A. J. Curtis & Co., Hickory, Pa.

Saskatchewan Power Corp. has completed a 113-mile 8-in. gas line from Regina to Yorkton and will have a 76-mile 6-in. line installed by the end of August. Marine Pipeline & Dredging, Ltd., handled construction. Contract for the 24-mile 8-in. Wilkie-Unity line has been let to Robb Construction, Ltd.

A 24-mile 20-in. gas line will be laid by Mountain Fuel Supply Co. near Calville, Utah. Contract has been awarded to Hood Construction Co., Whittier, Calif. The project is under way.

Also for Pipeliners . . .

IN THE NEWS: One of biggest pipeline projects—Alberta to San Francisco—will go before FPC soon (p. 40) . . . Transwestern will seek revision of FPC order on its Texas-to-California line (p. 57) . . . Problems of Sahara-to-Europe pipeline across Mediterranean are under study (p. 62).

PLUS THESE TECHNICAL REPORTS: Lakehead pipeline installs new electrically powered pumping stations (p. 66) . . . New correlation for two-phase flow (p. 100).

LPG Industry Facing Some Big Changes

- Butane demand is headed for outer space as refiners use increasing amounts for alkylation. A butane shortage is expected within 5 years. More butane is being produced, but the resulting increase in propane output is causing another problem—how to dispose of so much propane?

W. A. Bachman
Tulsa District Editor

LPG marketers generally are enjoying a good year.

Supplies are adequate. Sales are increasing. Prices have been fairly firm, except for a midsummer softness in propane.

Despite these signs of prosperity, the LPG industry within the next 5 years probably will face a market upheaval from:

. . . A shortage of butane. An approaching jump in demand for this product from refiners who need it to make isobutane for their alkylation units probably will take butane completely off the retail market and create an outright shortage.

. . . An oversupply of propane. This is expected to be a byproduct of stepped-up butane production.

The net result, according to the men who buy and sell LPG, will be this: A new push for greater supplies of butane and a coordinated drive to find new markets for propane.

Buisness good . . . Right now all the market statistics point to brisk business in LPG.

Total sales for the year through mid-July were up 12.32% over the same period last year. Total production at processing plants and refineries was up 17.84%.

Stocks also increased, but they were considered manageable in view of the heavy volumes being traded these days.

At mid-year propane held in underground storage was estimated at 41 days' supply compared with a 22-day supply at this time last year. Butane-propane mixtures in underground storage amounted to a 15.6-day supply last year.

One big supplier characterized the current market as good in price and demand for butane but soft for butane-propane mix and straight propane. He observed: "You really have to make some sharp deals to keep the propane business away from the price cutters."

Prices in the LPG industry are a jungle. Variances occur because of different quotations for contracts, spots, freight differentials, and tank car or truck lots.

Spot prices currently are: Propane 2 to 4 cents a gallon, butane-propane mix 3 to 4 cents; butane 4½ to 5; and isobutane 6½ to 7

A 1-cent price increase is expected early in September when one of the major suppliers automatically withdraws its summer-fill discount.

Marketers report that butane and isobutane are enjoying a steady, year-round demand with prices, as a result, rather stable. Propane still has a seasonal demand and price because of its increasing use as a heating fuel.

Summer business of all the LPG fuels has increased this year. Total LPG sales in June were 36.7% greater than for the same month last year. They were 25.6% greater for the first half of July.

June propane sales totaled 295 million gallons, up 13%. The first half of July was even better—nearly 157 million gallons sold, a 21.7% jump over the same 15 days last year.

Butane sales in June were 222 million gallons, up 53%, and, for first half of July, they were 104 million gallons, up 36.6%. Butane-propane mix sales totaled 62 million gallons in June, up 18.9%. For the first half of July, the total was 34 million gallons, up 51.6%.

Sales of isobutane were 64 million gallons in June, a 66% gain and 27 million gallons for the first part of July, a 36% increase.

The butane picture . . . Nearly all marketing and refining men agree the demand for butane is headed through the ceiling.

A recent study by one refiner on future availability of butane in refining points to an outright shortage in this country. On a 5-year projection, it thus appears that refiners will not be able to procure enough isobutane for their alkylation needs.

Refiners are betting on alkylate to provide them the most economical blending component for high-octane premium gasoline. At the start of the year, alkylate capacity in this country was 370,120 bbl. daily. Construction projects during the year will add 23,450 bbl. daily more for a total of 393,570 bbl. daily (OGJ, Mar. 30, p. 112).

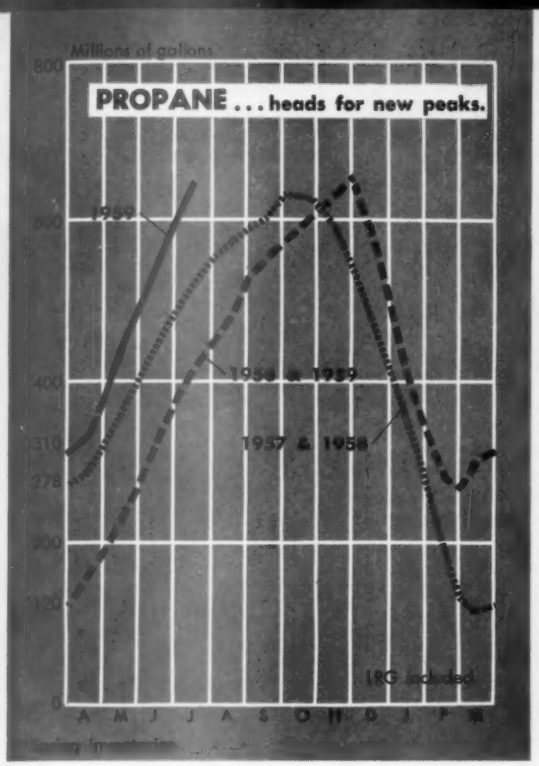
Butane enters the picture because

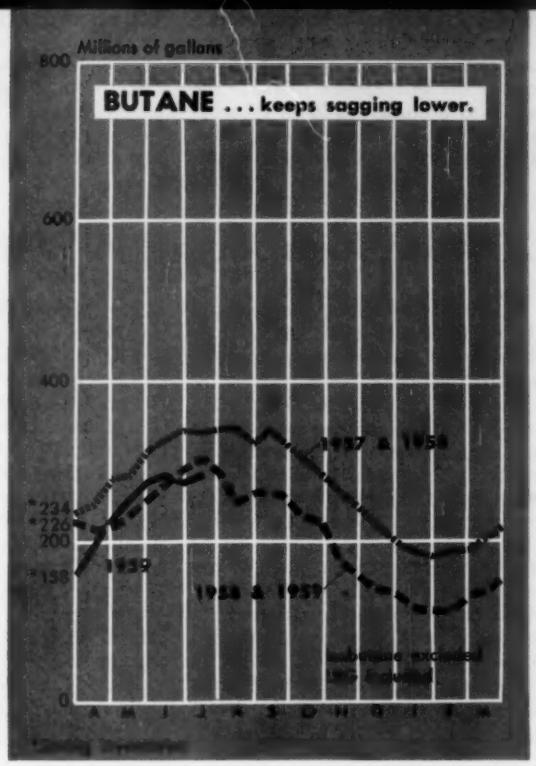
LPG Balance Sheet for First 6½ Months of 1959

Product—	PRODUCTION (Thousands of gallons) At Plant	At Refinery	Total	% Change	SALES (Thousands of gallons) Total	% change from 1958
Propane	1,989,694	809,728	2,799,422	+13.94	2,677,713	+ 8.69
Butane	1,115,397	312,367	1,427,764	+22.34	1,274,388	+19.42
B-P Mix	390,466	39,756	430,222	+ 2.62	424,304	— 6.92
Isobutane	334,946	. . . . .	334,946	+21.47	308,287	+18.77
Other Mix	374,125	311,188	685,313	+37.3	645,248	+29.26
Total LPG	4,204,628	1,473,039	5,677,667	+17.84	5,329,940	+12.32

Source: API

Trends in LPG Stocks:





The seasonal rise and fall of propane and butane stocks tell a story of the comparative market demand for the two products.

For the last 4 years, propane stocks have hit record peaks in the build-up season and have not gone down at the same rate in the heavy-demand season. But butane stocks have shown the opposite trend—a smaller buildup and heavier drawdown.

alkylation combines isobutane with three types of olefins—propylene, butylene, and amylene.

Indications are that even full use of all butanes available from natural gas, casinghead gas, and stabilized crude will fall short of producing the isobutane needed in future alkylation.

The recent study arrived at these estimates on:

. . . Butane supply. On the average, natural gas and casinghead gas will yield .045 barrel of mixed butanes for every barrel of crude oil and natural-gas liquids produced in this country. An additional .015 barrel of butanes may be obtained from each barrel of stabilized crude.

. . . Butane needs. To alkylate olefins resulting from catalytic and thermal cracking of crude fractions butane requirements will range from 8.9 to 14.33% of the crude production.

This means that based on 1959's first half daily average crude production of 7,180,000 bbl., 430,800 bbl. daily of butane could have been made available. But if all the olefins available in the same period were alkylated, the need for butane would range from 639,000 to 1,028,894 bbl. daily.

This sort of butane pinch has not yet been felt because refiners are not geared to alkylate a large fraction of their olefins. But as this trend continues, an outright shortage is expected to develop.

Process authorities predict that refiners will find adequate stocks of mixed butanes for isomerization and alkylation with the butylenes. But not enough will remain to alkylate all the propylene or amylene.

Signs clear . . . The butane demand from refiners will make the regular butane-propane mix used by many off-the-main householders in the south and southeast too expensive.

Retail LPG distributors see this and have suggested a switch to propane, which already is the dominant liquid gas fuel in northern climates.

One Oklahoma supplier early in the summer informed his distributors that the industrial demand for butane was growing so fast that the product is rapidly disappearing from the domestic LPG market.

He wrote, "We feel there will be enough butane mixtures available to take care of domestic requirements for perhaps the next few years, but unless there is a concerted effort on the part of all LPG dealers to gear their operation towards eventually selling only propane, they will find some rough times ahead."

And another LPG dealer notified his regular butane customers that he was discontinuing delivery of butane for domestic use this fall. He urged the customers to install propane systems and offered to install the tanks, test the lines, and adjust all appliances at cost and either finance the outlay or set up a lease-rental plan.

The LPG marketing executive of one large refiner commented, "It's hard to make many people realize a shortage is coming in butane because current statistics don't show it. There's

no shortage now—our inventories are high enough. But I feel we will begin feeling the shortage next year and the trend will grow quickly after that."

One of the major LPG suppliers said actually butane is a big factor only in the southeastern market. The switch to propane has been in progress for 5 years. He said his company sells very little of its butane, retaining it for gasoline and petrochemicals.

What's ahead . . . LPG marketers talk of several possibilities when butane gets short for domestic use.

One big possibility is importing LPG from foreign areas where an abundant supply could be tapped. Refiners may either start bringing in more LPG in their crude or start importing it in the liquefied-gas stage. Tankers are being built to handle LPG.

Another possibility is that future auto requirements may change so that the pressure may be relieved on alkylate and thereby butane.

Meanwhile, refiners are concerned about future supplies of butane and LPG retailers are pressing customers to convert to propane.

La Motte Joins Journal in Washington

CLYDE La Motte, veteran oil writer and editor, joined the staff of The Oil and Gas Journal August 20 as district editor in Washington.

La Motte will succeed Joe Reilly, who is leaving both the oil business and the writing field to become a rancher in New Mexico. Reilly's last Watching Washington column appears in this issue on page 43.

La Motte recently has been editor of Washington Report, the weekly newsletter published by the U. S. Chamber of Commerce. Before that he was news editor of Petroleum Week.

La Motte earlier had spent 4 years in Washington with the Platt publications, Oilgram and National Petroleum News.

The new Journal Washington editor is 42, a graduate of the University of Texas with a degree in journalism, and a member of Sigma Delta Chi, professional journalism fraternity.

He entered editorial work with the Austin, Tex., Tribune upon graduation in 1940 and worked up to assistant city editor. He moved to the Houston Post in 1941 and, except for 3 years in military service, spent 10 years there, as reporter, night city editor, assistant city editor, sports columnist, and sports editor.

In 1951 he moved to Washington and into the field of oil writing.

PROCESSING BRIEFS . . .

Construction of a sulfuric acid alkylation unit, with a short-cut processing approach to LPG production, will begin in October at Great Northern's refinery at Pine Bend, Minn. Capacity will be 1,500 to 2,000 bbl. daily with enlargement to 3,800 bbl. daily planned later. Refinery Engineering Co. will build the unit. Design makes a single processing step of feed preparation and depropanizing operations and provides debutanizing operations at a fraction of the cost for a full debutanizer. Completion is scheduled in mid-1960.

Cosden Petroleum Corp. of Big Spring, Tex., has licensed its process for making polybutene to Texas Butadiene & Chemical Corp. Texas Butadiene will manufacture polybutene at its Channelview plant near Houston, and Cosden will market the entire output. An expansion program has been completed at Cosden's Big Spring refinery, doubling its production of polybutene to 2,400,000 gal. a year.

Construction will start soon on a distillate hydrotreater at Shell's Houston refinery. The $2-million unit, to be built by Fluor Corp., will be completed during the second quarter of 1960. Employing Shell's trickle-flow process, the unit will not increase plant capacity but will improve the quality of 30,000 bbl. of furnace oil and diesel fuel daily.

A natural-gasoline plant to process 100,000,000 cu. ft. of gas from Aneth field, southeastern Utah, is being built by El Paso Natural Gas. Contractor on the $10-million plant is Fish Engineering. Liquids recovery will be about 300,000 gal. daily.

Catalyst for Atlantic Refining's Catforming process will be supplied by Engelhard Industries under a licensing agreement between the two companies. The process uses a platinum catalyst with a distinctive yield-quality pattern, producing less light gases than other reforming catalysts.

Valera Gas Co. has started operation of a new natural-gasoline plant, 2 miles north of Valera, Tex., in the Warner field of Coleman County. It has a gas-processing capacity of 2,500,000 cu. ft. daily and 10,000 gal. of butane and propane daily. The company takes gas from 49 wells, sells liquids to Warren Petroleum and residue gas to Lone Star Gas. James P. Dunigan heads a partnership owning the plant.

Also for Refiners . . .

IN THE NEWS: Multigrade pumps win two more converts (p. 38) . . . A 1-cent gasoline tax hike now appears sure in Congress (p. 39) . . . Rocky Mountain area has top effective octane rating (p. 41) . . . Processing plant near Fort St. John expanding (p. 42) . . . LPG industry may face a shortage of butane within next 5 years (p. 48) . . . Settlement reached at Whiting refinery may set pattern in other strikes (p. 54) . . . Public Health Service plans to study the role of exhaust fumes in smog (p. 55).

PLUS THESE TECHNICAL REPORTS: Ireland's first refinery is on stream (p. 74) . . . How first electrostatic desulfurizer has performed for Cities Service (p. 78) . . . A look at ethylene glycol today (p. 85) . . . Tank gaging now automatic at Port Moody (p. 99).

NEW ENGINEERING DEVELOPMENT

Dowell Announces the "Acid Guide"

Now available to you—a new, greatly improved method for planning and predicting the results of oil well acidizing treatments. The "Acid Guide," developed and now in use by Dowell, offers you an engineering basis for answering these questions:

1. **Is an acid treatment advisable?**
2. **What acid treatment would be best—kind of acid, addition agents, volume, injection rates, other considerations?**
3. **What results can I expect?**

Field results show an amazingly high degree of correlation with answers calculated from the "Acid Guide." You get this sort of information only from Dowell.

Today, when you ask your Dowell representative to **engineer** an acid treatment with the aid of the "Acid Guide," the chances are good that he will recommend an entirely different treatment than you expect. Acid volumes may be either smaller or larger. A different kind of acid may be recommended. Higher injection rates may be considered. As a matter of fact, the Dowell engineer may recommend fracturing or other treatments instead of acidizing.

In any case, field results indicate that you are likely to get more profit from your acidizing dollar.

Key to the "Acid Guide" is an "acid index number" which varies with the formation and the type of acid. Using this number as a basis, it is possible to select the most efficient treatment and to predict the probable results. The idea is to open up the largest possible drainage area at the lowest possible cost—by giving you the deepest possible penetration of the acid before it spends. This is achieved by balancing the amount and kind of acid and the injection rate against the solubility of the formation.

For example, Dowell engineered a treatment for a well completed in the Strawn Lime of Midland County, Texas. This formation is found at about 11,000 feet and is tight, dense, and almost completely soluble. The well did not produce at all after perforating. 360 gallons of BDA* (Breakdown Acid) was applied to clean the face of the pay, and production went to 27 bopd. The allowable is 180 bopd.

The "Acid Guide" showed that, under the existing well conditions, the optimum treatment was 12,000 gallons of Retarded Acid. It also showed that the maximum amount of regular acid that would be helpful was 2,000 gallons. The operator elected to treat the well with the 2,000 gallons of regular acid. Production rose to 53 bopd. Because of these results, the operator decided to try a 4,000-gallon regular acid treatment. However, as had been predicted with the "Acid Guide," there was no further increase in production.

Then the operator decided to follow the "Acid Guide." 12,000 gallons of Retarded Acid was injected at 5⅓ bbls. per minute. Production rose to 84 bopd. **The $3,500 cost was paid out in two months.**

That is just one example of the way the "Acid Guide" is increasing profits for operators. This engineered approach to acidizing is available **only** from Dowell, and is provided to you at no extra cost.

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New Labor Pattern Seen

. . . in contract ending Whiting strike. Compromise gives measure of protection to both management and the union.

STANDARD OIL Co. (Ind.) returned production schedules nearly to normal last week after settling strike troubles in refineries at Whiting, Ind., and Wood River, Ill.

The company still was plagued by strikes at its Sugar Creek, Mo., refinery and at the El Dorado, Ark., and Texas City plants of American Oil Co., a subsidiary.

The return to work at both Whiting and Wood River was orderly as successive units went back on stream.

For most of the 4,800 returning workers at Whiting it was their first day's work in nearly 3 weeks. The Independent Petroleum Workers of America, Local 1, called them out on strike July 28. Their total loss in wages exceeded $1.6 million.

The Wood River workers are members of Central States Petroleum Union and walked out August 5 when IPWA members motored across state from Whiting and set up picket lines. This walkout prompted a damage suit by the company and counter suit by the union.

The terms . . . Indiana Standard apparently protected its management prerogatives in the strike settlement.

The strike issue was how the refinery will be manned.

In this respect the company won two points:

. . . **A no-layoff provision** was not included in the contract. The union had demanded this at first. The company protested it would have frozen employment at present levels and blocked any company efforts to increase efficiency. Union negotiators dropped the demand as part of the settlement.

. . . **A common labor group** will be created by consolidating a number of small work forces. This will allow the company more flexibility in scheduling work crews.

Other major areas of agreement in the contract are:

. . . **Early shift relief.** This is extended to all employes who work the refinery shift schedule regularly.

. . . **Severance pay** extended for term of contract.

. . . **Extended medical** expense plan offered to employes represented by the union. It will become effective when accepted by 75% of eligible workers.

. . . **Plan to offset overtime** is devised for employes of the mechanical division. It will go into effect only after an IPWA-represented employe has been laid off during the term of the contract. Then employes who have accumulated more than 40 hours of overtime must take a week off without pay. The aim is to spread out the work and prevent layoffs.

Indiana Standard's chief negotiator, Joseph P. Sullivan, commented after the agreement: "We believe the new contract is a good settlement for both parties. Improvements were made without encroaching on management's responsibilities to conduct the company's business in the most efficient manner."

Other strikes . . . Prospects were slim for an early settlement at three other Indiana-system plants.

The union involved in all three strikes remaining is the Oil, Chemical, and Atomic Workers International Union.

The situation at these plants:

. . . **Sugar Creek.** Latest bargaining session produced no signs of agreement. The company withdrew its offer of 6-months' wage reopener and instead proposed a no-strike clause for duration of the new contract.

Management also sent a letter to employes explaining their rights to continue picketing or end the strike and return to work. The letter also set plant for those who want it.

About 30 strikers immediately returned to work and were given jobs in the plant to augment supervisors. The force put back on stream the fluid cat cracker and a vapor recovery unit.

. . . **El Dorado.** Bargaining session also failed to reach agreement. The National Labor Relations Board, meanwhile, dismissed a charge of unfair labor practices filed by Amoco against the OCAW. An Amoco spokesman indicated the company may appeal the ruling.

Supervisors who have been operating an Ultraformer in the struck plant prepared to put a cat cracker on stream.

. . . **Texas City.** Federal negotiator met separately with both Amoco and OCAW representatives without results. Plant Manager B. F. Babin said local union is being used by the international and that Texas City negotiators are not confining themselves to local issues.

Babin claimed the union wants veto power over plant management. The union said the company is striving to destroy craft lines. While the

END OF A STRIKE is recorded here as IPWA and Indiana Standard representatives sign new contract for Whiting refinery. Negotiators are, seated left to right, Charles Hallum, IPWA secretary-treasurer; Dan Georgevich, vice president; Ralph Flusche, president; Joe Sullivan, plant E&CR superintendent; Art Endres, refinery manager. Standing: Jim Bell, assistant labor relations supervisor; Phil Oak, assistant manager; Jens Norgaard, mechanical superintendent; and Chet Barter, labor relations supervisor.

strike continues, supervisors are operating some units.

In other activity on the Gulf Coast, OCAW's new local at Humble's Baytown refinery is now electing officers and making plans for its first meeting with management for a contract.

Exhaust-Fume Study

. . . by U. S. Health Service is approved by House.

THE HOUSE last week passed a bill directing the surgeon general of the Public Health Service to make a study of motor-fuel exhausts as a factor in air pollution.

The bill, now awaiting action in the Senate, is aimed at determining the public-health effect of exhaust fumes. It would require the surgeon general to report his findings to Congress within 2 years of the effective date of the legislation.

As introduced, the bill would have prohibited the introduction into commerce of new motor vehicles which discharge substances in amounts found by the surgeon general to be dangerous to human health. It was toned down in committee to provide for further investigation of the problem.

Rep. Paul F. Schenck (R-Ohio), who introduced the original bill, expressed the hope that within 2 years the surgeon general "can make recommendations that will make possible remedial action."

Degree in Marketing Offered

. . . for the first time this year. On-the-job training is included in 4-year course planned at University of Tulsa.

A 4-YEAR college course with a petroleum marketing major is being offered for the first time this September at the University of Tulsa.

The marketing graduates will receive a B.S. degree in business administration. A masters degree, with 5 years of study required including advanced marketing training, is provided. A 2-year intensive program in oil marketing is rewarded by a certificate in petroleum marketing.

Dean M. M. Hargrove of the college of business administration says this is the first full-scale attempt to establish a college degree primarily on petroleum marketing. A 4-year course is offered at Western Michigan State University, near Detroit, in a distributive education program.

He said 76 students already have enrolled for the 4-year program beginning in September. Enrollment of 110 is anticipated. Those enrolled are from New York, Chicago and cities in Texas, Oklahoma, Michigan, Minnesota, Nebraska, and Kansas.

A meeting of a steering committee, which includes representatives of 20 oil companies, was held at the university recently. One year's on-the-job training is required for a degree. Companies have agreed to hire students for weekend work, for half-day work during school periods, and for full-time summer work at $1.25 an hour.

Specific studies in marketing are scheduled in each of the eight semesters. The curricula also includes courses in accounting, English, management, mathematics, economics, speech, political science, business law, psychology, business analyses, geography, finance, and religion.

Four members of the faculty, who will handle most of the marketing teaching assignments, have had practical oil company experience. T. W. Coover has worked two summers each with Standard of Indiana and Shell companies and one year with Seismograph Service Corp.

Marshall W. Milligan is a former Pan American Oil Corp. employe; Lloyd R. Saltzman has conducted surveys on the service-station level for several companies; and Will W. Day formerly was with Utah Oil Refining Co. B. R. Davis, manager of trade relations for DX Sunray Oil Co., is chairman of the steering committee.

Estimated cost to a student, per semester, for tuition, entrance fee, books, room, food, cleaning and incidentals is $900. Chief function of the steering committee is to coordinate on-the-job training for students.

INDUSTRY BRIEFS . . .

The largest tanker ever built in the United States for U. S. flag service, the 65,926-dwt. National Defender owned by National Transport Corp., was launched last Wednesday at the Newport News Virginia yards of Newport News Ship Building & Dry Dock Co.

It's the second largest vessel in the U. S. merchant fleet, exceeded only by the super liner, United States. Its displacement tonnage is greater than the supercarrier Forrestal. The National Defender is 810 ft. long, has a 104-ft. beam and 60-ft. depth. Its cargo capacity is 478,635 bbl. It will have the lowest per barrel cost of operation of any American flag tanker.

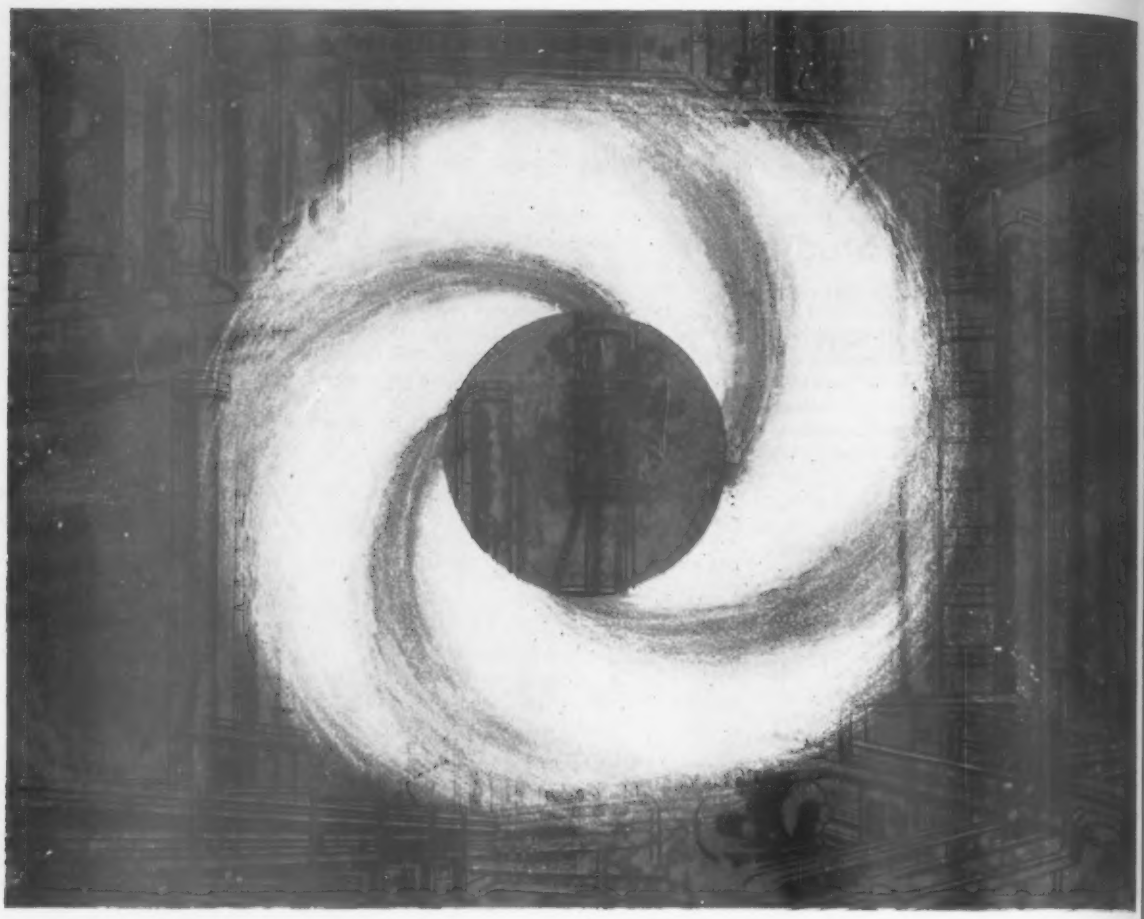
Sale of 800 billion cubic feet of gas over a 20-year period to Coastal States Gas Producing Co. was announced last week by Associated Oil & Gas Co., Houston. Price, yet to be approved by FPC, is 16 cents per M.c.f. The gas will be delivered by Coastal States to Texas Illinois Natural Gas Pipeline Co. for movement to the Chicago area. The gas will come from a big new field in the Fitzsimmons area of Jim Wells County, Texas. Associated has drilled 10 wells on a structure about 10 by 5 miles in size. Reserves already have been estimated conservatively at more than 1 trillion cubic feet.

Oil & Gas Corp. of America has brought in a gas discovery near Houston producing between 60 and 75 million cubic feet of gas daily. The well is about 12 miles east of Houston. It was drilled to 9,644 ft. on the Highland salt dome.

Helmerich & Payne, C.A., Venezuelan subsidiary of the Tulsa firm, has acquired International Drilling Co., Inc., C.A., in a stock exchange-merger deal. Equipment involved was four shallow drilling and workover rigs. Helmerich & Payne operates eight drilling rigs in eastern and central Venezuela.

A new booklet, Standard Terminology for Gasoline and Heating Oil Marketers, has been published by the Marketing Division of API. It revises a study issued in 1956 by including heating oil marketers and dealers. Material is based on a survey of classifications and terminology now in use. George H. Glenn, Texaco, New York, and N. L. Turkevich, Continental, Houston, directed the project.

J. M. Huber Corp. has received FPC approval for sale of gas to Colorado Interstate from the West Panhandle field in Texas. Price was set at 16 cents per M.c.f. An FPC examiner previously had denied the application.



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Change Is Sought

. . . by Transwestern in FPC order on California line. Construction is delayed.

TRANSWESTERN Pipeline Co. will return to the Federal Power Commission to ask a revision of an order authorizing construction of a pipeline from southwestern gas fields to California.

Transwestern officials, in announcing their course of action, said the delay will not affect ultimate plans to build the long-sought 1,809-mile line.

"We have not changed our objective to build the pipeline," President Mills Cox said in Houston last week. "Whatever it takes to do the job, we will do it."

The FPC imposed sharp conditions on Transwestern in approving the $191.17-million line. It required cuts of 1 to 6 cents per M.c.f. in prices paid to gas producers as well as certain tariff revisions (OGJ, Aug. 17, p. 94).

Cox said the company has not yet prepared its filing papers but said that the terms of the authorization "must be adjusted to where the producers can accept them."

While new action before the FPC will delay the start of construction for the line, Cox remained confident that all parties involved will reach agreement.

"We have the market, the gas, and the financing," he said. "We know we are going back to the commission, but we can't say at this time just what we will ask, or when."

Transwestern has let contracts to H. C. Price Co., Houston Contracting Co., and R. H. Fulton & Co. for building the line. Pipe already had been purchased and delivered to the right-of-way to avoid any delay because of the steel strike.

Products Terminal Planned

ADVANCES in automation at products terminals are reflected in a project planned by Great Lakes Pipe Line Co.

The company plans a "satellite-type" delivery terminal with two 30-000-bbl. tanks and a two-spot transport loading rack near Olathe, Kans. It will ease the demand on the Kansas City terminal.

Great Lakes will boost capacity of its El Dorado, Kans.-Kansas City line by 48% by installing a 1,100-hp. diesel pumping unit at El Dorado, an unattended 1,500-hp. electric station near Emporia, and an unattended 1,250-hp. electric unit near Lawrence.

A new unattended diesel station, to be operated from Fargo, N. D., will be installed near Hillsboro, N. D., to handle increased business at the Grand Forks, N. D., terminal on the 6-in. line from Fargo.

Pioneer Passes Test

. . . and loads a new cargo of liquid gas for Europe.

THE Methane Pioneer, a history-making tanker that is pioneering ocean transport of liquid methane, started on its fourth voyage to England last week after passing inspection of the American Bureau of Shipping and Lloyds Registry of Shipping.

The inspection is required annually for vessels built to specifications of the two authorities.

Constock International Methane, Ltd., and the British Gas Council, owners of the Methane Pioneer, said the inspection showed that the ship and its special liquid-methane features are in excellent condition.

The companies said the ship's aluminum tanks containing the liquid at —258° F., the special balsa wood insulation, and all the cargo-handling facilities showed no signs of deterioration despite the extremely low temperature service.

After completing its third voyage, the Methane Pioneer went into dry dock at Mobile on August 5 and last week moved to Lake Charles, La., to take on its fourth cargo for delivery to the British Gas Council's terminal at Canvey Island on the River Thames.

The owners said the ship will continue its present operations for several months.

Brine Disposal Plans Due

ORDERS ASKING detailed reports on plans for disposal of brine from 2,772 wells in 67 Southwestern Arkansas fields have been sent 196 producing companies by the Arkansas Water Pollution Control Commission.

This is the second order issued under a new Arkansas law, permitting severance-tax deductions for operators providing underground disposal systems. Entire cost of these disposal plants can be deducted over a 5-year period. The Arkansas tax is 4% or 12 cents a barrel on wells producing 10 bbl. daily or less and 5% or 15 cents on wells producing more than 10 bbl. daily. (OGJ, April 20, 1959, p. 74).

Tulsan Bucks Odds

. . . with 7,500-ft. wildcat in northwest Washington.

ANOTHER wildcatter is moving into Washington in an effort to make it more than a one-well state.

Russell Cobb Jr., Inc., of Tulsa will drill a 7,500-ft. wildcat in extreme northwest Washington on a farmout from Sinclair Oil & Gas Co. Location has been staked and a site cleared for the test, to be spudded in 60 to 90 days. It will test the Blakely formation.

The location is near the Pysht lumber camp at Pillar Point, one-half mile inland from Juan de Fuca strait which separates Washington from Vancouver Island, Canada. It is about 30 miles west of Port Angeles in 4-31n-11w, Clallam County.

Other activity . . . Other wildcatters are busy in western Washington (OGJ, Aug. 17, p. 261).

Shell Oil Co. was drilling below 3,023 ft. last week in its 1 Sturdevant test in the Winlock area of Lewis County about 35 miles south of Olympia.

Tideland Oil & Gas Co. spudded in its 6,500-ft. test about 11 miles north of Ocean City in Grays Harbor County. Washington's only producer, Sunshine Mining Co.'s 1 Medina, is located south of Ocean City.

Also in Grays Harbor County, in the Copalis Beach region, Win-Cal Exploration Co. was planning to deepen its 4,381-ft. 22-1 Swanson. This test was originally spudded in last April, but it has been idle.

Quiz due in air fuel ban

A CONGRESSIONAL committee will investigate the Pentagon's decision to abandon its program for development of a high-energy aircraft fuel.

Chairman Overton Brooks (D-La.) of the House committee on science and astronautics said hearings may be held this session.

In announcing the investigation Brooks said, "It is reported that the Air Force and the Navy based their decision, in part at least, on the grounds that they had no further requirement for the project."

Brooks said the committee is interested in determining why it took the services 5 years "and some $200,-000,000" to reach the decision. He said he understood the National Aeronautics & Space Administration was still interested in the project.

PHOTOS IN THE NEWS

Pipelining in the Gulf

AERIAL VIEW of the 340-ft. laying barge being used in construction of Transcontinental Gas Pipe Line Corp.'s new offshore supply lateral off Louisiana.

The barge, owned by Brown & Root, Inc., has a 360-ft. twin-float "stinger" extending behind to enable the pipe to slide into the water.

Each 40-ft. joint of the heavily-coated 16-in. pipe weighs 7,000 lb. The special work barge lays 100 joints each 12-hour shift.

Transco also is laying offshore lines in three other areas off the Louisiana coast.

Hats Off to Safety

A SALUTE to safety was given by this group of Shell Oil Co. refinery employes at Norco, La., after learning they had topped the company's nationwide manufacturing department safety record.

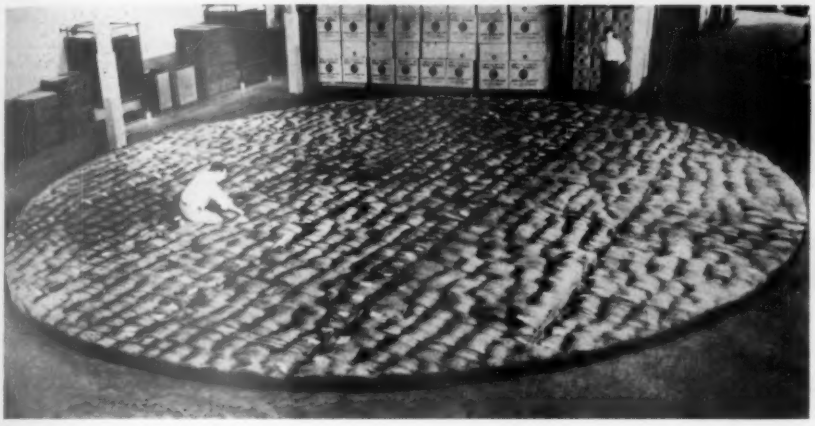
The 1,200 Norco refinery employes have passed 4 million accident-free man hours since Christmas Day 1957.

The plant was designated as the safest refinery in the United States during 1958 by the American Petroleum Institute.

Teracruzer Tryout

CROSSING a flooded rice paddy in East Pakistan, this eight-wheel-drive Teracruzer is getting its first commercial trial in oil-field use.

Two of the cross-country cargo carriers, built by FWD Corp. for military use, were used by Standard-Vacuum Oil Co. to haul equipment and supplies over a 14-mile stretch of flooded road from a railhead at Bogra to the site of a wildcat.



Steel-Wire Pancake

READY for service in a 38-ft. diameter vacuum tower is this king-sized mist eliminator designed to prevent heavy oil droplets from being carried overhead with a clean gas-oil product.

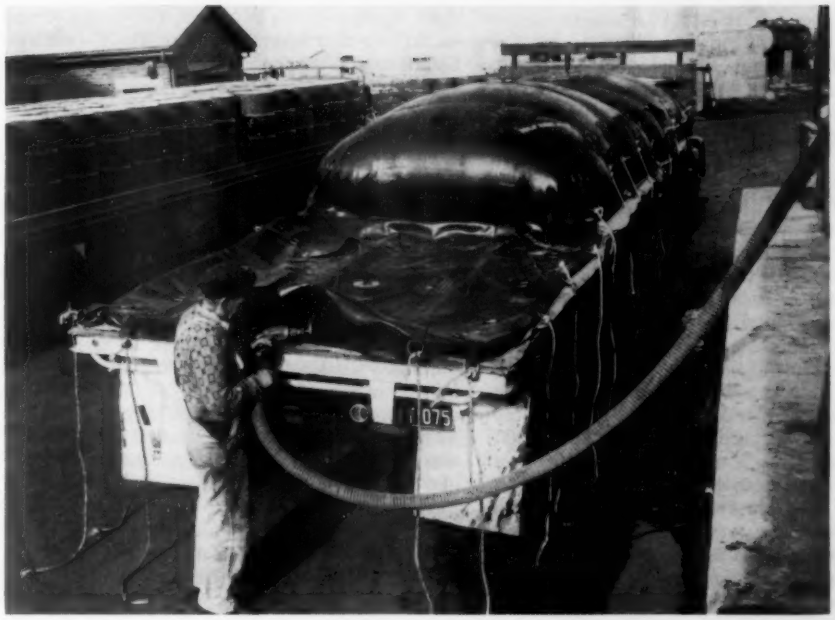
Fabricated by Metal Textile Corp. from chrome-nickel stainless steel, the pad weighs 1½ tons and contains more than 2,000 miles of stainless steel wire.

Rubber Tanks Pass Test

AFTER successful trials, collapsible rubber tanks will be used in Australia by BP Australia, Ltd., for transporting petroleum products on semi-trailer trucks.

The company has used the tanks to haul up to 1,200 gal. of products. BP now plans to install three 1,000-gal. collapsible tanks on each of the trucks of one of its distributors.

The tanks will be used on long hauls and will enable the distributor to back-load other goods from distant delivery points.



Iranian Wildcat May Set Depth Record

- The well launches Pan American International's exploration program on the 6,000-sq.-mile offshore concession obtained from the Iranian Government for a $25-million bonus.

WITHIN a few days, a bit will start cutting through the subsea formations in the Persian Gulf off Iran in a wildcat that may well set a depth record for the Middle East.

The well can already qualify for the biggest overhead. It already carries a $30-million price tag and the kelly hasn't made a revolution.

Aside from this pretty distinctive feature, the test can qualify for some others. It's the first for Pan American International on the 6,000-sq.-mile offshore concession granted more than a year ago by the Iranian Government. The well will go down in 129 ft. of water about 80 miles offshore.

If it reaches its projected 16,000-ft. depth, it will easily be the deepest drilled in the Middle East.

The big DeLong-type mobile drilling barge slated for the test was towed to Iran this spring from the Gulf of Mexico. It was at this point that the best laid plans of the oil company and its drilling contractor hit a snag. Both had hoped for an early summer spudding date. But, politics took a hand.

Pan Am has built a permanent camp at Khosrowabad on the Shatt-al-Arab below Abadan and planned to outfit the barge for drilling here after its ocean trip. Because the still unsteady revolutionary government of Iraq claims control over the Shatt-al-Arab, these plans had to be shelved.

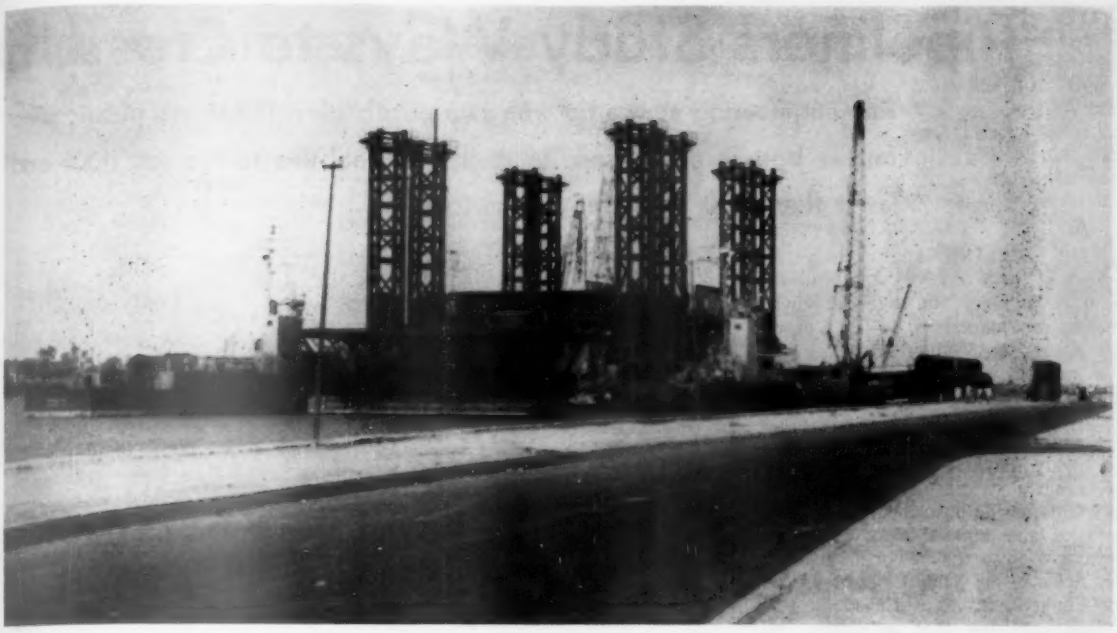
Only the river separates Iraq from Iran and it's a narrow firebreak in a politically tinder-dry region. Anchoring the massive barge in the disputed river could have set off a hassle neither Iran nor Pan Am wanted. It was towed north up the Karun river above Abadan into strictly Iranian territory for outfitting.

It is all but beached on the edge of the shallow river at Khurramshahr about 40 miles north of the Pan Am permanent camp. Here company engineers, personnel of Seacat Marine Drilling Co., and DeLong are adding 125 ft. in three sections to the 100-ft. legs of the barge.

Drilling target . . . The somewhat less than convenient location for the final outfitting of the big barge has delayed spudding the first well at least 6 weeks. The company now hopes to have the barge on location within a few days.

Once drilling gets under way, the barge will be supplied both by boat and helicopter. Location of the first test is more than 75 miles from the camp at Khosrowabad and this distance will mean some logistical problems.

Seismic work has revealed a large gently folding structure which the company will explore with the deep test. Pan Am hopes to encounter the prolific Asmari limestone which produces in all Iran's fields at the rela-



ANCHORED in the Karun River at Khorramshahr, the DeLong barge is being outfitted for drilling. The barge will be moved within a few days to the well location about 80 miles off Iran.

tively shallow depth of 3,200 ft. Below that point the prime targets will be the Eocene and Cretaceous. The latter is productive in Kuwait, across the Gulf.

The Pan American test is a big one in terms of money and the all-out effort of Standard Oil Co. (Ind.) to reenter the Middle East. The company surprised the oil world a year ago by taking on National Iranian Oil Co. as an equal partner and offering a $25-million bonus in order to get the concession (OGJ, May 5, 1958, p. 84).

Indiana obviously believes it can find a lot of oil offshore. It will need a lot of oil to split profits down the middle with the Iranians and then pay a 50% income tax to the government after that. The test to be spudded soon is the only way to settle industry arguments over the wisdom of the deal.

Other tests . . . The Pan Am well is one of three important tests of the northern Gulf waters this summer.

The Japanese-owned Arabian Oil Co. hardly got its well under way to the southeast when it blew out and caught fire (OGJ, Aug. 10, p. 80 and Aug. 17, p. 117).

The blaze was snuffed out and the well brought under control, but not before the derrick, drawworks, drawworks drive, all derricks tools, and the substructure were destroyed.

"Considering the fact that there was a 20-in. stream of gas with flames shooting 100 ft. in the air, we have come out of this very well," Monty Garrison, managing director of International Drilling Co., said last week.

Garrison says he expects to be able to ship replacement equipment to the platform and resume drilling "in 90 to 100 days." The drilling contractor said that Kuwait Oil Co., American Independent Oil Co., AGIP, Cameron Iron Works, Micoperi, and the Kuwait Government were "extremely cooperative" in lending assistance and facilities to bring the well under control.

There was a show of oil in the well, but no tests were taken.

During the fire fighting, there was an oil slick floating around the platform. There was some heavy, viscous crude mixed in with the gas and salt water which blew out the surface casing.

The contractor is scheduled to reenter the hole once new equipment arrives. The well was drilling at 1,500 ft. when the blowout occured.

To the north of Pan Am's location, SIRIP, the Italian-Iranian company, is setting piling in 18 ft. of water for a permanent-type platform for its first test of the concession which adjoins Pan Am on the north. The Italians have diverted a LeTourneau 3-legged platform originally scheduled for drilling here to offshore Sicily.

Japanese Eye Indonesian Oil

. . . but latest deal hits snag. Permina Petroleum wants to reduce the amount of crude involved in the agreement.

JAPANESE with an eye on North Sumatra oil supplies are apparently no nearer moving the Indonesian crude into Japanese refineries than they were more than a year ago when the dickering began.

Agreements in principle between the Japanese and the Indonesians have been announced several times, but a hitch has developed in the latest of these.

Ibunu Sutow, head of Indonesia's state-owned Permina Petroleum Co., and a Japanese group headed by Ataru Kobayashi, former head of the Japan Development Bank, made the latest deal. It called for the Japanese to extend credit of 60 billion yen (about $170,000,000) for development of North Sumatra fields which were never returned to Royal Dutch-Shell after World War II. In return for the credit, the Japanese would be allowed to take half the crude production at 30% under world oil prices.

Permina Petroleum has recently notified the Japanese they want to alter the agreement to sell the Japanese only 40% of the production and at a 10% discount.

Pipeliners Study Ways to Cross the Me

- Fish Engineering comes up with two possibilities: Either use plastic pipe on the bottom of the sea, or anchor a steel line to the sea floor and let it float 300 ft. under the surface.

THE PIPELINE industry today is grappling with one of the world's most fascinating, but toughest, engineering problems: How to lay a pipeline across the Mediterranean?

A number of companies are working on the problem. No plan is ready for the test.

Some of the construction theories are highly imaginative. But most engineers agree it will take imagination to overcome the obstacles lying in the path of the builder who wants to move gas from the newly discovered gas fields in the Sahara Desert to the fuel-hungry nations of Europe.

One company that is putting its engineering know-how to work on the problem is Fish International Corp., subsidiary of Fish Engineering Corp., Houston, an outfit that has tackled some of the world's biggest pipeline and engineering jobs.

Fish is dealing with SEPLI (Ste. d-Etudes de Pipeline Intercontineutaux), a group of French international transporters and industrialists.

Fish doesn't propose to have the solution yet. But it has collected some ideas worthy of study.

The routes . . . Two routes across the Mediterranean currently are receiving the most attention, although there are others under consideration.

One would make the crossing at Gibraltar, probably at the west entrance.

The other would cross from Algeria near Oran to the southeast tip of Spain at Cartagena.

The Gibraltar crossing has obvious advantages. The water distance on the west side, crossing from Cap Spartel in Morocco, is about 16 miles. Water depths run to about 1,500 ft., and some sections are much shallower.

The Oran-to-Cartagena crossing would be 100 to 116 miles, and water depths are perhaps as great as 6,000 ft. or more. This crossing would cut the over-all distance of the line—Sahara to West Germany—by some 300 miles.

Other routes have been suggested that would send the line island-hopping to Italy across Sicily or via Sardinia and Corsica.

Kind of pipe . . . A major engineering problem faced by the pipeliner is the laying of pipe along an unditched sea bottom, the contour of which is unknown.

The solution may lie in plastic pipe that is sufficiently flexible to follow the contour wherever it leads.

Plastic pipe, in small diameter, was used on D-Day to supply fuel to the Allied landing forces in World War II and is now being manufactured for offshore oil operations. Shell Oil Co. has laid a 4½-in. line in offshore Louisiana.

What is needed for the Mediterranean operation, however, is a large-diameter plastic pipe, at least 12-in. And even with this size, perhaps eight lines would have to be laid to handle gas from a 36-in. land pipeline.

Because 12-in. plastic pipe could not be wound on a reel in the manner that 4½-in. pipe is now handled, Fish is suggesting a daring plan that a manufacturer might undertake. This would be to convert an old aircraft carrier into a floating factory and manufacture the pipe at the laying site.

Still unknown is whether 12-in. plastic pipe, or even a greater size, could withstand the great pressures of the seabottom.

Extensive, and expensive, tests are needed to determine the maximum diameter of plastic pipe that will meet the rigid specifications called for in the Mediterranean project.

The only manufacturer of underwater plastic pipe for the oil business is the Manchester, England, firm of British Insulated Callenders, Ltd. BIC currently is promoting its flexible product for offshore operations but, so far, only in the smaller sizes.

Mediterranean Sea

However, the company has received inquiries on larger sizes, and the matter is under study.

Another approach . . . There are other construction theories under review by pipeline engineers.

One such theory, in which Fish is showing interest, would attempt to "float" the pipeline across the Mediterranean about 300 ft. below the surface.

This would be accomplished by using the principle of the suspension bridge—inverted.

The floating pipeline would be held in place by vertical lines leading to horizontal lines attached to seabottom anchors a mile apart. The horizontal lines would arc upward from anchor to anchor to reduce the length of the vertical lines required.

A construction plan such as this, if found practical, would eliminate the monumental problem presented by the great pressures at the seabottom and also would make it possible to repair the line.

The economics . . . A trans-Mediterranean gas pipeline, reaching from the gas fields to the mid-European consumer, would cost an estimated $600 to $750 million.

Could it pay out?

Geologists who have studied the new-found gas reserves in Algeria, particularly at Hassi R'Mel northwest of Hassi Messaoud oil field, believe the proposed pipeline could count on a deliverability of one-half billion to one billion cubic feet of gas daily.

If the pipeline ran through the industrial sections of Spain and southern France and terminated in the Ruhr industrial area of West Germany, it should tap sufficient markets to pay its way.

Studies are being made to supply this big potential market with liquid methane—piping natural gas to the North African coast, converting it to liquid methane, tankering it across the sea, and then reconverting to natural gas for transporting through pipelines.

Some oil men, however, see liquid methane only as a stopgap method of moving gas to Europe. They think it will be years before a pipeline spans the Mediterranean, and liquid methane may be the answer until one does.

What next? . . . Whoever builds a pipeline from Algeria to the Ruhr will have to deal with several governments, principally the French.

Morocco, Spain, Belgium, and West Germany will figure in the negotiations, and each will make its own stipulations in granting access rights.

A French combine currently is making oceanographic studies of the Oran and Gibraltar routes, and certainly the project in its final form will be a joint affair involving the capital, the engineering talents, and the construction know-how of a number of companies and countries.

But the key to eventual success of the project, which certainly would become one of the engineering wonders of the modern world, is the Mediterranean crossing.

The deepest pipeline built to date is in 300 ft. of water off California near Los Angeles. At Gibraltar the depth is five times as great and the distance more than twice as great. At Oran the depth is more than four times as great as Gibraltar's and the distance six times as great.

If regular steel pipe were laid on the sea floor, steel manufacturers would have to come up with a thick-wall pipe of, say, 1 to 1½ in., compared with ⅓ in. for an average thickness on land.

Pipe of such great thickness is certainly not very flexible. What would happen during powerful movement of waters in the subseas is an unanswered question with dangerous implications.

"We are in the preliminary stages," says a Fish engineer. "Nobody knows yet just what we can do."

But Fish and others are trying to find out.

Oil Is Trouncing Coal

. . . in Europe in spite of efforts by West German Government and labor unions in Great Britain to stem the tide.

THE COAL that once ran Europe's factories and heated its homes is taking a beating from oil in the market place, but governments and labor unions—not coal—are fighting back.

Coal has been giving ground steadily to oil in recent years as petroleum fuels take an increasing share of energy requirements. This has become so much the pattern that it has been widely accepted as inevitable. But, forecasters and economists have always conceded a static position for coal in a continually rising energy picture.

Coal is now slipping so badly in its own backyard that the government of West Germany is taking a hand against competing oils, and labor unions in Great Britain are screaming for similar action.

The infant, government-imposed price cartel on fuel oil in Germany collapsed last week under weight of tons of coal. In Great Britain, the coal industry is in such bad shape that miners unions are trying to rally the support of other unions to support a "use-coal-and-not-oil" movement.

West Germany . . . Germany's fuel-oil cartel had a reluctant birth early this year with the Bonn Government acting as midwife.

Alarmed at more than 13 million tons of coal stockpiled and going begging and a startling 54.5% increase in fuel-oil consumption in only a year, the German Government pressured the country's major oil marketers into the agreement.

The country's major oil marketers had to quit becoming sellers. They agreed to quit looking actively for more markets for the rest of the year. They also agreed to peg West German fuel-oil prices on U. S. Gulf quotations plus shipping costs and to quit cutting prices (OGJ, Feb. 2, p. 77).

The theory behind it all was that the coal industry would have a year to adjust to the fiercely competitive and expanding fuel market. In this year the Ruhr's coal industry was to "rationalize" and shut down marginal mines, generally tighten up its operation, and theoretically get ready to compete with oil.

This, plus a 70% curtailment of coal imports from the U. S., was supposed to reverse the trend toward oil and cut back on rising stocks of above-ground coal. It didn't work.

Stocks of coal at Ruhr pitheads climbed 40% during the first 6 months of this year to almost 17 million tons. The major oil marketers stayed with the cartel agreement and sold fuel oil at the pegged price of $21 a ton (about $3.10 a barrel). Coal con-

tinued to lose ground at an average price of $18 a ton.

Then independent marketers hit the unhappily hogtied majors with price discounts of as much as 90 cents a barrel as they scrambled for the new markets the majors were pledged not to go after.

When the word leaked out that the Bonn Government was considering a whopping sales tax of $7.40 a ton (almost $1.10 a barrel) on fuel oil, the dam broke. Esso A. G. (Jersey Standard) pulled out of the cartel price agreement. The other major marketers, Shell, Mobil Oil, BP Benzin Petroleum, and Deutsche Erdoel followed suit.

New Esso Well Makes Libya a Major Oil Area

LIBYA last week clinched its claim as the world's newest major oil province.

Esso Standard (Libya) tested a 4-mile stepout of its 5-month-old Zelten discovery at the rate of 15,000 bbl. of 39°-gravity oil. The well produced no water on tests of a 145-ft. Paleocene limestone section from 5,770-5,915 ft.

The flow rate of the second well was 2,500 bbl. daily less than in the Zelten discovery, but the section tested so far is 50 ft. short of the zone found in the discovery. Last week crews were coring the remainder of the productive zone in Zelten 2.

The new well confirms without a doubt a major oil find for the Jersey Standard company in its big concession No. 6 in Cyrenaica province in eastern Libya. Location for the third well has already been staked 5.4 miles southwest of Zelten 1.

Jersey officials last week almost discarded their guarded caution about the new oil find. They will not discuss the size of the structure tested by the first two wells, but concede they apparently have found a major oil field.

The two Zelten wells drilled so far have established an oil column of almost 300 ft. with extremely good porosity.

A specially built light rig has already been shipped to Libya for development drilling in the field. It is expected to arrive at Zelten in October and the company hopes to begin drilling its development wells at the rate of one every 45 days.

The heavy rig which drilled the discovery and the stepout 4.3 miles to the southeast will be moved into the northern part of the big concession block for more wildcatting. Esso drilled three dry holes in the northern part of the big 25,690-sq.-km. block (about 9,919 sq. miles). The concession was granted December 15, 1955, and at the end of the first 5-year period Esso must relinquish 25% of the acreage.

The Jersey company hopes to use the discovery rig in wildcat testing of every possible structure on the big block before the end of 1960, when it must decide what portion of the concession to give up. During the next 18 months the company hopes to drill another 18 Zelten wells with the light rig.

The new Esso field is not the only oil find made to date in Libya by any means, but it is the best find yet. Five other companies have made what are apparently commercial oil discoveries in the country since the exploration play began to pick up speed less than 2 years ago.

The discovery . . . Esso's Zelten 1 electrified North Africa in general and Libya in particular when it came in for 17,500 bbl. daily in April. Aside from the effect that the well had in establishing Libya as unquestionably good oil territory, its political implications were even greater.

Like the French oil finds in the Algerian Sahara, the Esso discovery in Libya was a severe blow to Arab nationalists who feel they are in a position to demand, and get, just about what they want because the Middle East is the world's prime source of oil.

Zelten 1 was completed and shut in during the first Arab oil congress in Cairo. Militant Arab leaders tried not too successfully at this congress to serve notices on western oil companies that they were in the driver's seat and would demand more and more concessions.

The news of the new, and apparent major, discovery in Libya was a blow to Arabs who would like to hold Middle East production like a club over the heads of nations who need oil.

The French are very frank in their aspirations to establish the Algerian Sahara as an alternate source for Middle East oil so they can walk away from this political club.

The Esso Libya discovery flowed 17,500 bbl. daily on a production test of a 205-ft. section of Paleocene limestone topped at 5,460 ft. Five drill-stem tests of 25-ft. sections of this pay averaged 100 bbl. an hour of 37°-gravity clean oil.

Zelten is only 100 miles south of the Gulf of Sirte and 200 miles south of Bengasi. This places it in an enviable spot for a commercial oil discovery in relation to tidewater and inexpensive shipping facilities.

Working the State Delacroix No. 38. Here's a view of the 142-ft portable mast atop a Crown Rigs, Inc. barge in the busy Delacroix Island Field in Plaquemines Parish, La. The well, the State Delacroix Island No. 38, was drilled for Texaco Inc. At the time of the photograph, with the drilled depth at 9730 ft, the operator was beginning to set the 7-in. casing. The rugged Bethlehem rotary line was a 1⅜ in. 6 x 19, with independent wire rope core. In superb condition, because of its toughness and durability, it showed a potential of thousands of ton-miles in additional drilling applications planned in the area.

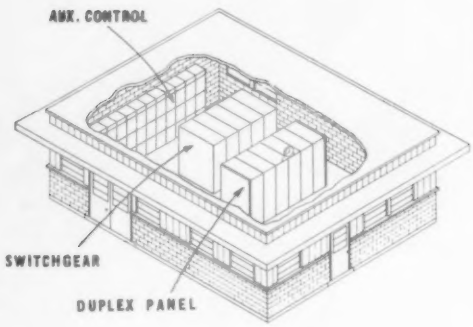
Bethlehem Steel Company, Bethlehem, Pa. *Export Distributor:* Bethlehem Steel Export Corporation

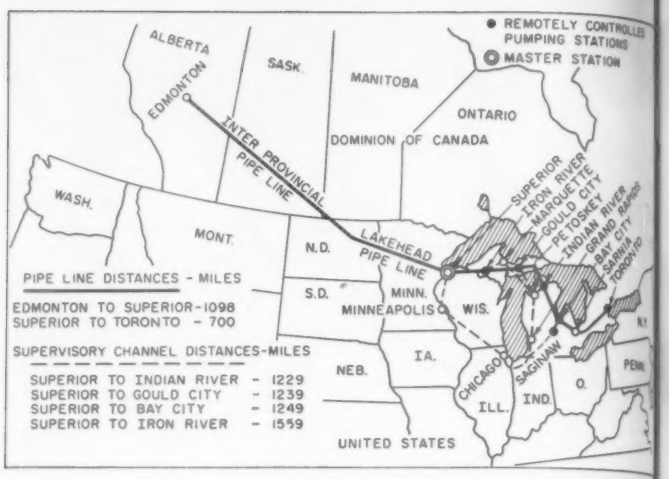
Mill depots and distributors from coast to coast stock Bethlehem Wire Rope

BETHLEHEM STEEL

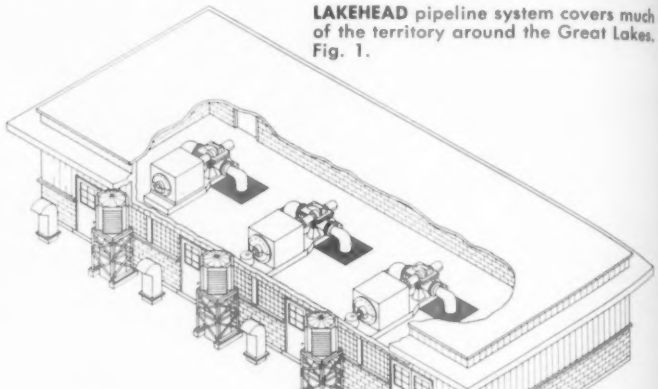
Lakehead Pipeline installs new electrically powered pumping stations controlled by supervisory equipment

BY
E. B. TURNER
and
W. D. WIEST
General Electric Co.

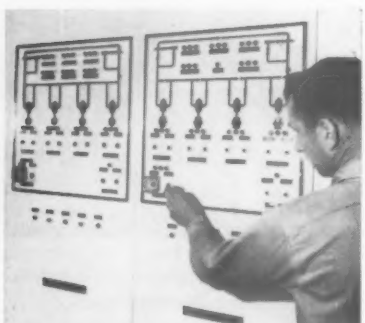




LAKEHEAD pipeline system covers much of the territory around the Great Lakes. Fig. 1.



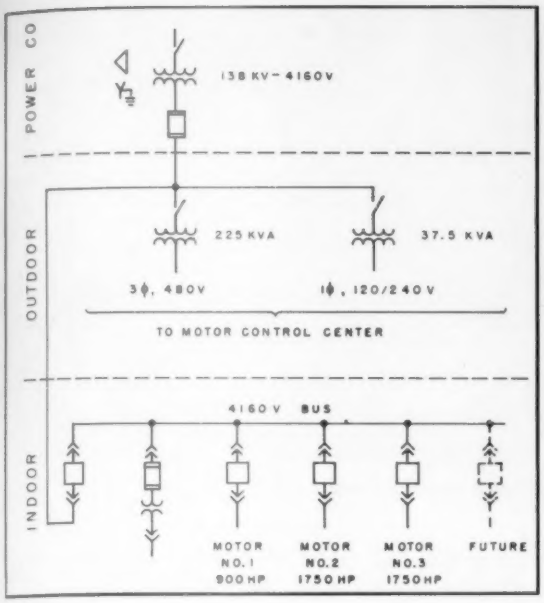
TYPICAL station layout is shown in this illustration of Indian River facilities. Pump room is in separate building 150 ft. from control room. Fig. 2.



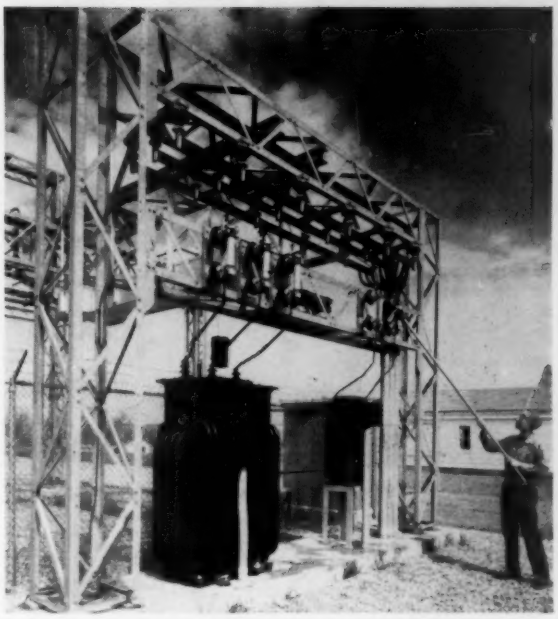
SUPERVISORY equipment panels in master stations show complete piping layout (at left). Fig. 2a.

Here are the latest concepts in unattended remotely controlled pipeline pumping stations of the general type that have been in use for a number of years. These new stations use new techniques and practices, and thus have many features not found in stations only a few years old. These new features include the following:

- An electrical pressure control system which eliminates the maintenance of a pneumatic system.
- Automatic load control equipment to insure continuity of operation.
- Unitized electrical design to allow individual unit isolation without disturbing station operation.
- Grouping of all operating controls, sequence control and protection in one factory-wired and assembled panel to minimize interconnections.
- An electrical protection system for station pressures, pump and motor bearings, and vibration to provide trouble-free operation.
- A supervisory system, with digital telemetering operating over a teletype circuit, which provides all necessary controls and indications with a minimum number of supervisory control and indication points.



ONE-LINE DIAGRAM of typical pumping station. Fig. 3.



OUTDOOR SUBSTATION for typical pumping station. Fig. 4.

ELECTRICALLY powered and remotely controlled pumping stations are fast becoming the backbone of oil-pipeline systems. Electrically powered stations represent over 90% of the existing installations. Those under remote control represent approximately 25% and this percentage is constantly increasing.

Three of such electrically powered pumping stations with supervisory control and indication equipment have recently been placed into operation by Lakehead Pipe Line Co., which is part of the Interprovincial Pipe Line System, longest crude-oil pipeline in the world.

This pipeline originates in the oil fields of Alberta, Canada, crosses the plains, and carries crude oil approximately 1,900 miles across one-half of the continent. At the beginning of 1956, the pipeline was using diesel pumping units at all of the main stations on the system.

As part of a continuing stepwise expansion program and because of the availability of power in the region concerned, Lakehead decided to consider using electric pumping and control. This was done in consultation with General Electric Co. to design and specify a complete integrated operating system using the latest developments and considering the special location problems.

One ever-prevalent problem in the installation of a pipeline pumping station is the large number of interconnections required between such elements as the motor, instrumentation, protection, control valves, etc. Since pipeline stations are usually located in relatively unpopulated areas, personnel experienced in heavy electrical construction are usually very limited. Thus an equipment arrangement which keeps the number of interconnections to a bare minimum and is still consistent with standard equipment design is important.

As a result of the study, Lakehead decided to add four electrically powered and remotely controlled pumping stations located at Indian River, Gould City, Bay City, and Iron River in Michigan. Three stations have been installed and are operating under remote control by supervisory equipment from Superior. Power is purchased in each case from the local public utility.

These three installations have increased the maximum throughput of this section of the line to 258,000 bbl. a day, achieved equal horsepower for approximately 60% of the previous plant investment, and reduced floor-space requirements per horsepower for each station by a fourth.

Fig. 1 depicts the supervisory-system interconnecting channel from the master station at Superior, Wis., the headquarters of Lakehead, to the remote stations at Indian River, Gould City, and Bay City. The interconnecting channel is a 15-pulse per second leased telephone-company circuit about 1,200 miles long.

General arrangement . . . First station installed was Indian River, located about 30 miles south of the Straits of Mackinac. Layout of this station is shown in Fig. 2. The pump room is a separate building 150 ft. from the control room. Elevation of the control room is approximately 3 ft. higher than the pump room to eliminate possibility of a hazardous condition occurring in control room in event of a major spillage.

The general arrangement of equipment used at this station has been followed with only minor variations on later installations. Therefore, the following description is representative of all stations.

Power distribution . . . The power distribution in the station is shown in the one-line diagram of Fig. 3. The incoming power is a 138-kv. system with a single transformation to 4,160 volts through three single-phase transformers. The power is fed (See Fig. 4) directly to a local station bus on a structure. At this point the station auxiliary power, 480 volts, 3 phase and 120/240 volts, single phase, is

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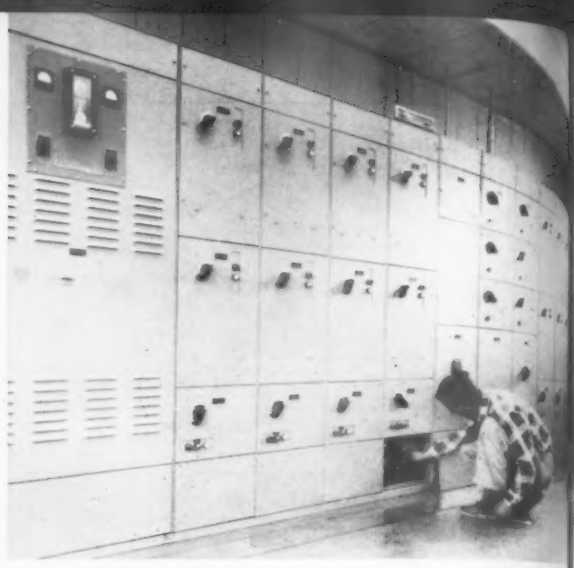


METAL - CLAD SWITCHGEAR for 4,160-volt pump motor. Fig. 5.

LOW-VOLTAGE SWITCHBOARD for auxiliary control center. Fig. 7.

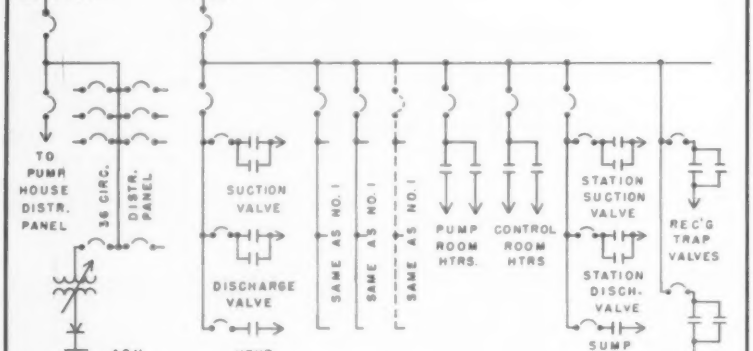
obtained through fused disconnecting switches.

The main power feeder runs by conduit inside the station where the station main breaker is located. Based on the fusing practice existing in the power-company substation, sufficient protection for the cable run to the indoor switchgear and the main breaker existed. The cable was sized for 120 amps. consistent with the rating of the main switchgear bus.

Metal-clad switchgear . . . The 4,160-volt indoor switchgear (See Fig. 5) is of the vertical-lift metal-clad construction. It consists of a main-station breaker unit, an auxiliary transformer compartment, and three motor breaker units. These are for the two 4,160-volt, 1,750-hp., 3,600-r.p.m. and one 4,160-volt, 900-hp., 1,800-r.p.m. full-voltage started squirrel-cage induction pump motors. Space is provided for the future installation of another 1,750-hp. motor breaker unit.

Station auxiliary power . . . The station has three sources of auxiliary power in addition to the power for the main pump units. These sources of power are 480 volts, 3-phase, 60 cycles, controlling the valves and other motor-driven auxiliaries; 120/240 single-phase for station lighting and other loads requiring this level of power. The d.c. power is 48 volts supplied from a 103-amp.-hr. (8-hour rate) nickel-cadmium-type battery, supplying the supervisory and the sequence control. The use of d.c. power for control purposes has a number of advantages as follows:

- Freedom from power interruptions due to the power-system irregularities or local line damage.
- The inherent memory provided by d.c. circuits which allows the continuation of fault indications to exist even though a.c. power may have failed.
- The ability to operate the supervisory equipment to provide up-to-date information on conditions existing at the station despite a.c. power failure.
- The increased reliability of conservatively rated d.c. control circuits.
- A reliable tripping source for the main and motor breakers.
- A reliable source of alarm and illumination power in the event of a.c. power failure.



ONE-LINE DIAGRAM of station auxiliary control center. Fig. 6.

Station auxiliary control center . . . A one-line diagram of the station auxiliary control center is shown in Fig 6. This control center was designed for minimum external interconnection and maximum operating flexibility. (See Fig. 7). The station battery and its charger are physically built into this lineup.

The auxiliary starters associated with each pumping unit are arranged so that they can be electrically isolated without disturbing operation of other units. The distribution panels for 120/240 and 48-volt d.c. power are also included in the lineup.

Pump motors . . . The motors (See Fig. 8.) are totally enclosed, base-ventilated units with Class A insulation, 40° C. rise over 40° C. ambient, with a 1.15 service factor. This provides the ability to operate at 15% over nameplate rating without exceeding 55° C. rise over 40° C. ambient when heavier crudes are pumped. The units are direct-coupled to centrifugal

pumps with limited end-play couplings.

The units are full-voltage started and accelerate to operating speed in approximately 8 seconds. Six resistance temperature detectors are installed in the stator windings and two in the motor bearings. This type of element is also used for pump-case temperature protection.

The lubricating-oil system for the 1,750-hp. motor is a flood type using a shaft-driven circulating pump. Cooling of the lubricating oil occurs in the finned lubricating-oil reservoir tank. The flood lubrication is supplemented by slip rings which provide lubrication during startup and some measure of backup protection.

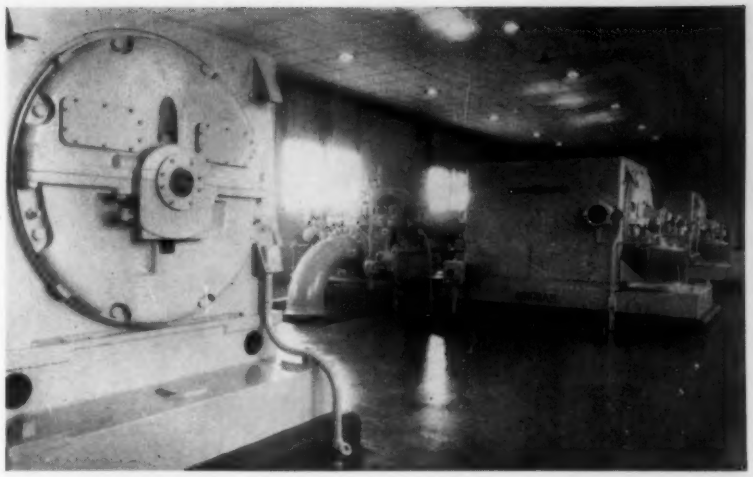
The 900-hp., 1,800-r.p.m. unit uses ring-oil lubrication exclusively. The cooling-air ducts are below floor level. Space heaters are automatically energized when a unit shuts down to reduce condensation to a minimum.

The main pump motors use external blowers to provide the necessary circulating air. Fig. 9 shows installation of intake and exhaust ducts for these units. In the area where the stations are located, relatively large snow accumulations are anticipated. Consequently, the overhang on the roof and the placement of the filter were designed to provide as much inherent protection against future snow fouling as possible.

The placement of the exhaust duct with relation to the intake is also designed to provide minimum recirculation of air from exhaust to intake, not only of an individual unit, but between adjacent units. Air intake is at low velocities while exhaust high velocities are discharged in a dispersing manner to prevent interaction or recirculation.

Duplex switchboard . . . The automatic sequence control is in a duplex switchboard (see Fig. 10) located in the control room. The equipment was designed in a sectionalized manner so that one panel, front and rear, was used for each unit sequence control. The station control uses two panels, front and rear, which also include the supervisory-equipment devices required for operating the station remotely from Superior, Wis. Fig. 10 shows the four unit pump-motor control panels and the two station-control panels from left to right.

The unit pump-motor sequence controls are built into individual panels capable of complete electrical isolation from the rest of the station without interruption of the other units in operation. Each unit includes individual annunciators, manual sequence control, indication of motor amperes, motor stator temperature, and pump discharge pressure.



ELECTRIC MOTORS rated at 4,160 volts provide power for pumps. Fig. 8.

The station-control panels include an individual annunciator showing only those faults or troubles which occur in the station as differentiated from the unit faults. Provisions for emergency stop, local or remote-control selection, station suction and discharge-pressure indication, station pressure-valve control and station electrical load in the form of watts, amperes, and volts are also included on these panels.

Station isolation valves . . . Fig. 11 shows a typical piping arrangement for a multiunit pumping station. With multiunit stations it is common practice to provide for isolation of the station from the line. The suction, discharge, and bypass valves are manually controlled on the Lakehead system. However, motor-operated valves may be furnished with controls at the valves and in the control room.

For unattended stations, remote supervisory control and indication has the advantage of providing rapid isolation of the station in emergency.

The pumping stations are provided with automatic startup and shutdown controls from either the local station or over the supervisory system. A master station-control transfer switch 43 selects either local or remote control of the equipment. The remote-control functions are inoperative in the local position except for emergency stop and supervisory indications. Likewise, the local-control functions are inoperative when remote control is selected except for emergency stop.

The master-station operator has complete control of the incoming line breaker, one 900-hp. pumping unit, two 1,750-hp. pumping units, one future 1,750-hp. pumping unit, and the suction-pressure index. Automatic indication of manual reset failure, automatic reset failure, station failure, low battery voltage, and remote-local control are always available at the master station.

Main breaker control . . . The 4,160-volt main incoming breaker for the transformer secondary is controlled by means of the supervisory system from Superior, or from the breaker control switch at the duplex switchboard, depending upon the position of the LOCAL-REMOTE selector switch 43.

PUMPING-STATION EXTERIOR, showing ventilating intake and exhaust ducts. Fig. 9.

DUPLEX SWITCHBOARD for pumping station. Fig. 10.

Before the breaker can be closed, the station-lockout relay must be in the RESET position, three-phase a.c. voltage in the proper sequence must be on the incoming line, and the permissive switch 69 at the metal-clad switchgear must be in the NORMAL position.

Motor startup . . . The individual pump-motor startup sequence consists of the following basic steps as shown in Fig. 12:

1. Press start pushbutton.

2. Start suction valve opening; start sequence timer; and start motor ventilating fan and confirm operation.

3. When suction valve is fully open: (a) Close vent valve, (b) close motor breaker, and (c) start discharge valve opening.

4. When discharge valve is fully open: (a) Energize motor low lubricating-oil pressure and pump-vibration protection, (b) energize motor-load control circuit, and (c) timer times out.

5. Sequence complete.

This startup sequence may be controlled from the START-STOP switch 101CS located on the duplex panel or by means of the supervisory control relay SC1 from the master station, depending upon the position of the master selector switch 43.

In either case, in order to start the sequence, the permissive switch 169 at the metal-clad equipment must be in the NORMAL position. The motor breaker 152 must be in the tripped position. Both the suction and discharge valves must be fully closed to energize device 120X. The unit lockout relay 186 must be in the RESET position. The unit master shutdown relay 105 must be deenergized. Voltage must be available on the bus as indicated by relay 147Y. And the pump-case temperature must be normal as indicated by device 126PCX.

The green lamp indicates that the unit is shutdown and both the suction and discharge valves are fully closed. The red lamp indicates that the unit is in operation and both the suction and discharge valves are fully open.

The starting signal originates with momentary closure of the START-STOP local-control switch 101CS or by relay SC1 which is actuated by remote control. Under normal conditions, the unit master startup relay 104 will pick up and seal in through its own contact and a time-delay opening contact of the unit incomplete startup sequence-timing relay 148.

The sequence will progress as follows as designated by the numbered circles in Fig. 12:

1. The suction valve 120S will start to open.

2. The unit incomplete startup sequence relay 148 will start timing.

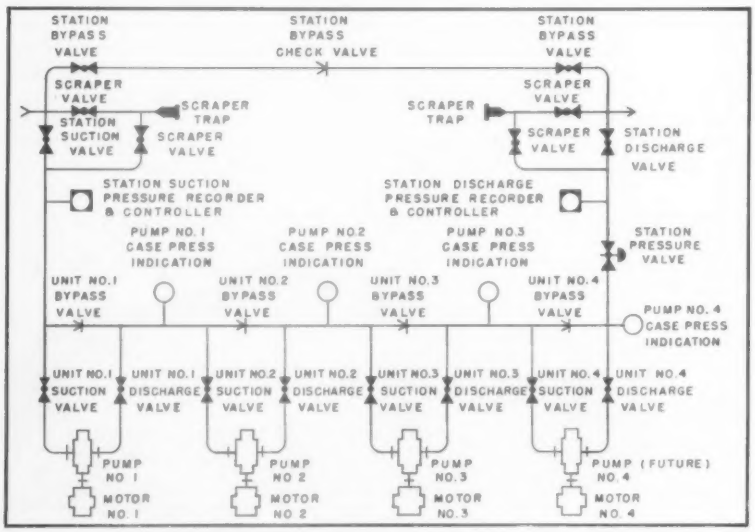
3. The suction valve auxiliary switch 120S/bc will open to deenergize relay 120X which in turn will start the ventilating-fan motor. The circulation of the ventilating air is checked by relay 180AR located in the air stream responsive to the flow of the ventilating air.

4. When the suction valve has fully opened, the suction-valve auxiliary switch 120S/ao will close to energize relay 120SX/ao and auxiliary switch 120S/bo will open to deenergize relay 120SY/bo. One contact of relay 120SY/bo will open to deenergize the vent valve auxiliary relay 120VX which will close the vent valve.

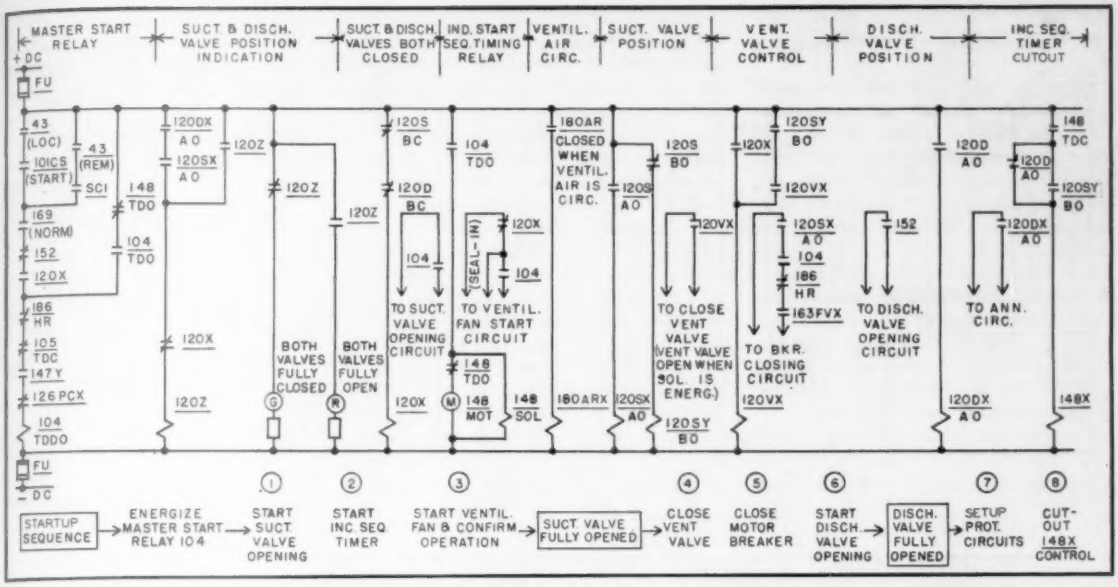
5. The pump-motor breaker will close to start the pump motor provided (1) the suction valve is fully opened as indicated by device 120SX/ao, (2) the unit master startup relay 104 is energized, (3) the unit lockout relay 186 is reset, (4) the ventilating air is circulating as indicated by device 163FVX, and (5) switch 169 is still normal.

6. The discharge valve starts to open when the pump-motor breaker closes.

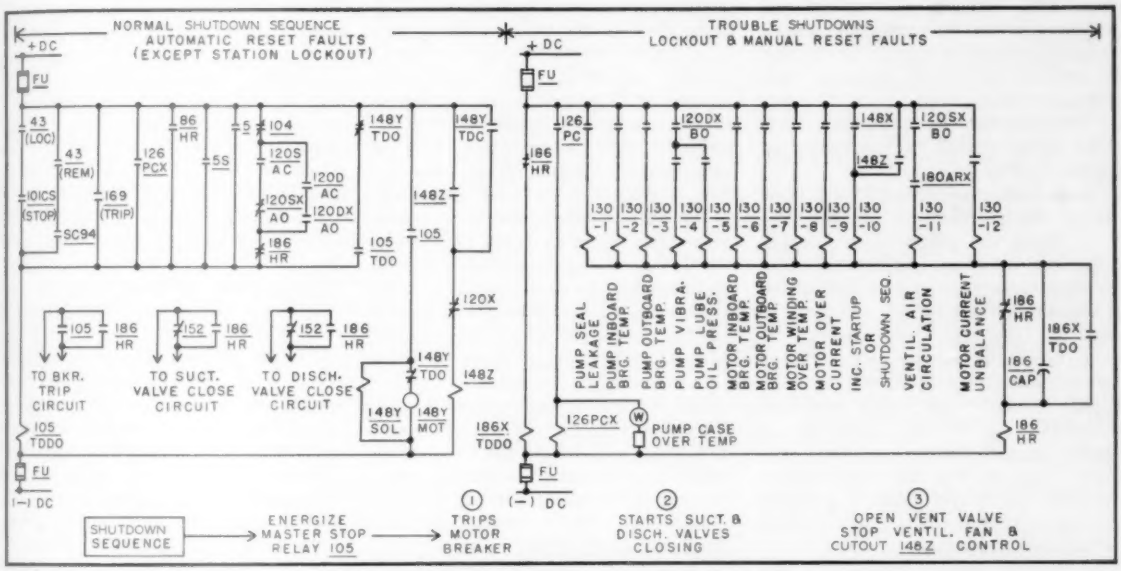
7. When the discharge valve has fully opened, the discharge-valve auxiliary switch 120D/ao will close to energize relay 120DX/ao. One contact of relay 120DX/ao will close to energize relay 120Z which will light the red lamp and disconnect the green lamp to indicate the unit is in operation. A second contact of relay 120DX/ao will close to insert the



PIPING DIAGRAM for typical pumping station. Fig. 11.



SEQUENCE CIRCUITS for unit startup. Fig. 12.



SEQUENCE CIRCUITS for unit shutdown. Fig. 13.

motor lubricating-oil pressure and pump-vibration protection into the unit annunciator and the unit lockout-relay circuit.

8. The discharge-valve auxiliary switch 120D/ao will open to cut out the circuit to the unit incomplete startup sequence-timer auxiliary relay 148X. The unit incomplete startup sequence timer 148 will time out to release the seal-in circuit to relay 104 and the sequence is complete.

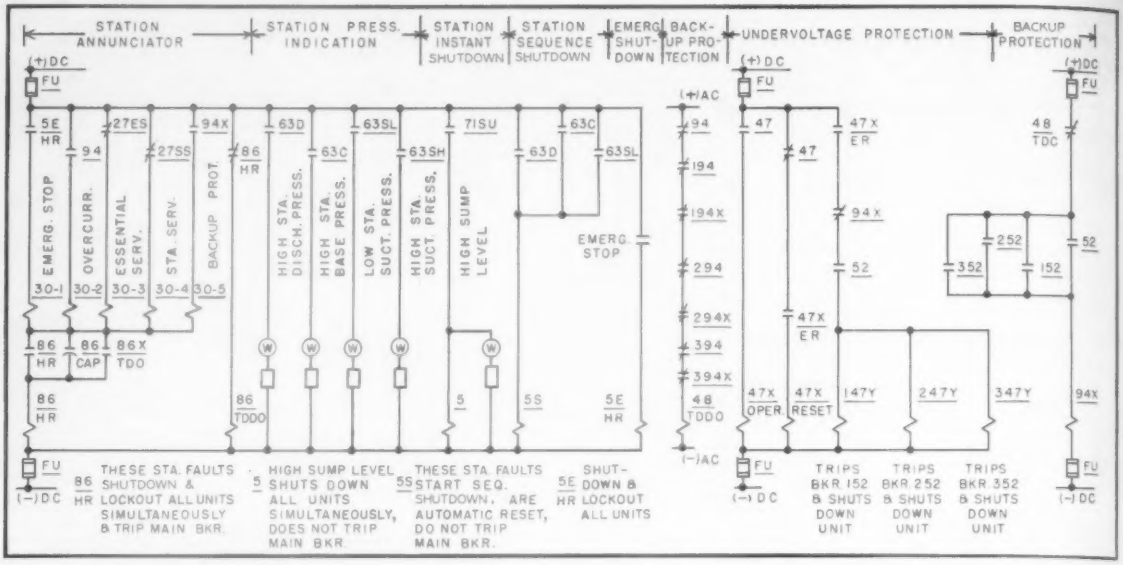
Should any operation in the startup sequence fail to function properly, the unit incomplete startup sequence timer 148 will time out and energize auxiliary relay 148X. The contact of relay 148X will operate the annunciator drop 130-10 and the unit lockout relay 186 which in turn will trip the pump-motor breaker as described under "Unit Shutdown Sequence" and close the suction and discharge valves depending upon how far the startup sequence has progressed.

Motor shutdown . . . The individual pump-motor shutdown sequence consists of the following basic steps as shown in Fig. 13:

1. Press stop pushbutton.
2. Start timer, and open motor breaker.
3. When motor breaker is open, start suction valve and discharge valve closing.
4. When suction valve and discharge valves are fully closed: (a) Timer times out, (b) open vent valve, and (c) stops motor ventilating fan.
5. Sequence complete.

Fig. 13 shows a typical circuit for the normal shutdown sequence for the automatic-reset failures and the annunciator circuit for the lockout and manual-reset failures for one of the units. The unit shutdown sequence may be controlled from the unit master START-STOP switch 101CS or by means of supervisory control device SC94 from the master station, depending upon the position of the master selector switch 43.

In either case, the unit master shut-



STATION-PROTECTION CIRCUITS are set up for orderly shutdown in case of trouble. Fig. 14.

down relay 105 will pick up and seal in through its own contact and a time-delay opening contact of the unit incomplete shutdown sequence timing relay 148Y.

The sequence will progress as follows as designated by the numbered circles in Fig. 13.

1. A contact of relay 105 will close to trip the pump-motor breaker.

2. When the pump-motor breaker trips, one auxiliary contact will close to start the suction valve closing and a second auxiliary switch will close to start the discharge valve closing.

3. When the suction and discharge valves close, relay 120X will be energized through the valve auxiliary switches 120S/bc and 120D/bc as shown in the startup sequence schematic diagram Fig. 12. One contact of relay 120X will close to energize the vent-valve auxiliary relay 120VX which will open the vent valve.

A second contact of relay 120X will open to deenergize the ventilating-fan contactor and stop the ventilating fan and a third contact of relay 120X will open the circuit to the unit incomplete shutdown sequence-timer auxiliary relay 148Z. The unit incomplete shutdown sequence timer 148Y will time out to release the seal-in circuit to relay 105, and the sequence is complete.

The annunciator indicates faults as listed in Fig. 13. All of these items function to shut down the individual units and they require manual resetting except for pump-case over-temperature which allows for restart when the condition subsides.

Temperature and vibration protection . . . Temperature elements utilize resistance-temperature detectors (RTD's) embedded in the motor and pump bearings and the pump case with individually adjustable high temperature set points. The vibration protection utilizes a hydraulically damped electromagnetic type of vibration detector and provides adjustable vibration detection over a 0 to 3-mil amplitude range. The motor units have resistance-temperature elements installed in the stator windings to provide a means of protecting the motors against long-time overload conditions or uneven cooling conditions which could result from the blockage of some circulating-air passages in the motor.

The RTD elements are used in such a manner that one of the six available RTD's is connected to a relay which operates when the temperature existing in the stator winding exceeds a set value. When this is done, the other five elements are either left unconnected or connected to a switch and indicator which allows an operator to read the other five elements. An approximation of the temperature existing on the winding connected to the relay can be made from these other readings.

A more suitable arrangement appeared to be one where all six RTD elements are connected to an indicating and protection circuit. With this in mind a resistance-thermometer instrument with a protection element was used. This provides continuous protection and indication on any one of the six available resistance-temperature elements. A selection can be made of one which appears to be reading higher than the others and allow the protection unit to function on this element.

Station protection . . . Fig. 14 shows a typical arrangement for the station-protection equipment. Emergency stop relay 5E, incoming-line overcurrent tripping relay 94, loss of essential service voltage as indicated by relay 27ES, loss of station-service voltage as indicated by relay 27SS, and time-relay backup tripping relay 94X all cause station shutdown requiring manual resetting of the equipment. These will shut down and lock out all units simultaneously, trip the main breaker, and indicate on the station annunciator.

High station discharge-pressure device 63D, high station case-pressure device 63C, and low station suction-pressure device 63SL cause station shutdowns which permit automatic restarting of the equipment. These will not lock out the pump units or trip the incoming-line breaker. Relay 5S will be energized to shut down the pump units in sequence No. 1, No. 2, and No. 3 as long as the faults exist, and indicate by white lamps below the annunciator.

High sump level is detected by device 71SU and will shut down all pump units simultaneously but will not lock out the units or trip the incoming-line breaker. The station-shutdown relay 5 will be energized to shut down all the units and indicate by a white lamp.

The emergency trip button will operate the electrically operated hand-reset relay 5E which will shut down and lock out all units and must be manually reset. All these protective features are commonly provided in oil-pipeline installations.

The station backup-protection circuit provides a means to shut down the station should a breaker-trip cir-

cuit be energized and actual tripping fail to occur. Should the incoming-line overcurrent tripping relay 94 fail to trip the main breaker, or should any of the pump units overcurrent or unbalance-current auxiliary relays 194 and 194X fail to trip the motor breaker, relay 48 will be de-energized.

After a definite time delay, the contact of 48 will close to energize relay 94X which will operate the station-lockout relay 86 to shut down and lock out all units and trip the main breaker.

An electrical-type pressure protection system is mounted in the duplex switchboard. The pressure-detecting elements are strain gages which are connected to amplifier bridges. The output of each amplifier has adjustable high and low set points which provide the necessary station-pressure protection.

The pressure-control and regulating system is an electrical type which utilizes electrical sensing and control with the final valve position resulting from a conversion from electrical to hydraulic energy to provide the power for valve positioning.

In addition to the usual station pressure regulation on high discharge or low suction pressure, a third function, motor load, was incorporated. This motor-load limit was factored into the pressure-regulating system in order to provide some means of protection against excessive overloads on the motors and still provide maximum continuity of operation at the maximum available output.

The case pressures of the pump units are indicated on milliammeter receivers located on the individual pump-unit panels. The station suction-valve and station discharge-valve pressures are recorded on recording set stations located on the station-control panel. The pump-unit motor load is indicated on an indicating set station also on the station-pressure panel. Each set station is furnished with an electronic controller and an adjustable set point that determines the operating point of the controller.

Any one of the pump unit's motor loads may be selected by the station pressure-valve control-transfer switch. For example, when turned to the UNIT NO. 1 position, Pump Unit No. 1 motor-load transmitter is connected to the motor-load set station. If the switch is turned to the AUTOMATIC position, the largest pump unit running is automatically connected. White lamps located below the set station indicate which motor load is connected to the motor-load set station.

The outputs of the suction-pressure transmitter, the discharge-pressure transmitter, and the motor-load transmitter are connected to the manual station controller which operates the station-pressure-regulating valve. This valve is closed during initial unit start-up by the sequence-control relay and returned to the controller setting when startup of the first unit is complete.

The station pressure controller, in addition to being set locally, may be adjusted by supervisory control from the master station at Superior. The pressure-control lower-index relay and raise-index relay are timing relays adjustable for 1 to 6-second intervals. The 6-second interval is equivalent to a 30-lb. adjustment on the station controller. The timing relays actuate a motor-driven potentiometer unit which controls the automatic-reset station, which in turn operates the station controller.

Remote control . . . The supervisory equipment and the digital data logging on this system operate on separate interconnecting channels between the remote stations and the master station at Superior. This arrangement was the answer to a rather unusual problem encountered on this pipeline system. The main headquarters of the pipeline at Edmonton needed to obtain operating pressures from these remotely controlled stations directly.

The actual operating control, by supervisory equipment of the station, would only be from Superior and it would also be necessary to obtain pressure readings at that point. The pipeline system at that time was using

Appendix—Device Designation

Based on AIEE Publication No. 68, Supplement to American Standard C37.2-1956.

5	—Station Shutdown Relay.
5E	—Station Emergency Shutdown Relay.
5S	—Station Sequence Shutdown Relay.
27ES	—Essential Service Undervoltage Relay.
27SS	—Station Service Undervoltage Relay.
30–1 to 5	—Station Annunciator Drop Relays.
43	—Station Control Transfer Switch.
47	—Phase Sequence Voltage Relay.
47X	—Auxiliary Relay to Device 47.
48	—Backup Auxiliary Tripping Relay.
52	—Incoming Line A.C. Circuit Breaker.
63C	—Switch Responsive to Station High Case Pressure.
63D	—Switch Responsive to Station High Discharge Pressure.
63SH	—Switch Responsive to Station High Suction Pressure.
63SL	—Switch Responsive to Station Low Suction Pressure.
71SU	—Switch Responsive to Station High Sump Level.
86	—Station Lockout Relay.
86X	—Auxiliary Relay to Device 86.
94	—Station Overcurrent Tripping Relay.
94X	—Backup Tripping Relay.
101CS	—Unit No. 1 Master Start-Stop Switch.
104	—Unit No. 1 Master Startup Relay.
105	—Unit No. 1 Master Shutdown Relay.
120D/ac	—Unit No. 1 Discharge Valve Position Switch (open only when valve is fully closed).
120D/ao	—Unit No. 1 Discharge Valve Position Switch (closed only when valve is fully open).
120D/bc	—Unit No. 1 Discharge Valve Position Switch (closed only when valve is fully closed).
120D/bo	—Unit No. 1 Discharge Valve Position Switch (open only when valve is fully open).
120DX/ao	—Auxiliary Relay to Device 120D/bo.
120S/ac	—Unit No. 1 Suction Valve Position Switch (open only when valve is fully closed).
120S/ao	—Unit No. 1 Suction Valve Position Switch (closed only when valve is fully open).
120S/bc	—Unit No. 1 Suction Valve Position Switch (closed only when valve is fully closed).
120S/bo	—Unit No. 1 Suction Valve Position Switch (open only when valve is fully open).
120SX/ao	—Auxiliary Relay to Device 120S/bo.
120SY/bo	—Auxiliary Relay to Device 120S/ao.
120VX	—Auxiliary Relay to Unit No. 1 Valve Limit Switches.
120X	—Auxiliary Relay to Unit No. 1 Valve Limit Switches.
120Z	—Auxiliary Relay to Unit No. 1 Valve Limit Switches.
126PCX	—Auxiliary Relay to Unit No. 1 Pump Case Overtemp. Device.
130–1 to 12	—Unit No. 1 Annunciator Drop Relays.
147Y	—Unit No. 1 Auxiliary Relay to Device 47.
148	—Unit No. 1 Incomplete Startup Sequence Timing Relay.
148X	—Auxiliary Relay to Device 148.
148Y	—Unit No. 1 Incomplete Shutdown Sequence Timing Relay.
148Z	—Auxiliary Relay to Device 148Y.
152	—Unit No. 1 Pump Motor A.C. Circuit Breaker.
169	—Unit No. 1 Permissive Switch.
180AR	—Relay Responsive to Unit No. 1 Flow of Ventilating Air.
180ARX	—Auxiliary Relay to Device 180AR.
186	—Unit No. 1 Lockout Relay.
186X	—Auxiliary Relay to Device 186.
194	—Unit No. 1 Overcurrent Tripping Relay.
194X	—Unit No. 1 Unbalanced Current. Tripping Relay.
200 Series	—Unit No. 2 Devices.
300 Series	—Unit No. 3 Devices.
SC–1	—Supervisory Control Start Relay.
SC94	—Supervisory Control Stop Relay.

a leased teletype circuit extending the complete length of the pipeline.

A new 15-pulse-per-second channel was leased to perform the operating control functions between Superior and the remote station. The solution was a telemetering system which was capable of using the existing teletype circuit.

Supervisory system . . . The master-station supervisory equipment panels for two of the pumping stations are shown on Fig. 2a. The mimic piping layout with the control buttons located in the mimic layout gives the station operator a complete picture of each pumping station.

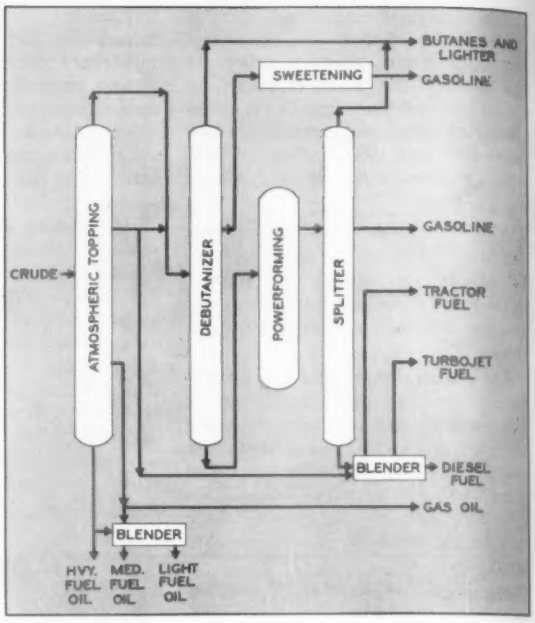
Each station is equipped with one station check point; five control and indication points for the three existing pump units, the one future pump unit, and the main breaker; one control point for raising or lowering of the station pressure-index setting; and five indication points for indicating manual reset failures, automatic reset failures, station failures, battery low voltage, and remote-local control.

The basic system is expandable to 128 control points. It is anticipated that each station will require between 16 and 24 points as a maximum.

The arrangement provides for a minimum number of supervisory control and indication points with a maximum amount of information transmitted to the master station at Superior. This arrangement is based on the philosophy that only those points which can be directly used by the dispatcher at the master station should be present in the supervisory equipment.

It is therefore possible to plan on controlling all four of the electrically operated remotely controlled stations by means of one supervisory system having a capacity of 128 control and indication points; only one 15-pulse per second interconnecting channel is used to accomplish this. At the master station a d.c. power supply was installed of sufficient capacity to handle the complete master-station equipment which is mounted on four separate panels (two of which are shown in Fig. 2a).

Data logging . . . The digital data-logging system uses a static-type measuring system utilizing positioning shaft encoders for station suction, case, and discharge pressures. The encoders provide a numerical teletype code. When a reading is requested by use of teletype selection, a programer provides station identification, the three pressure readings, and one test reading. Then it resets for subsequent selection.



Ireland's first refinery on stream

THE NEW 39,600-bbl. per stream day Irish refinery which has just recently come on stream at Cork is Ireland's first. The plant makes products for Caltex, Esso, Shell-Mex and B. P., the major companies selling on the Irish market.

Since there is heavy demand for fuel oils and not so much for high-grade gasoline, the refinery has no cat cracker. However, while the gasoline yield is small, the incorporation of a Powerformer into the process scheme assures good gasoline quality. The refinery produces two grades of gasoline, tractor fuel, turbojet fuel, diesel fuel, gas oil, and three grades of fuel oil.

Features of the plant are the use of air fins for cooling, thus diminishing considerably water-pollution hazards; the use of one central control room for all the processes; and the installation of a smokeless waste-gas stack.

The refinery was designed by Esso and constructed by Lummus Co. The marine terminal was built by George Wimpy, Ltd.; tankage was installed by Tank Erectors, Ltd., and refinery buildings were put up by L. P. Hegarty.

The site is 140 ft. above sea level near the excellent port facilities of Cork Harbor (at the village of Whitehead, just east of the port). The storage tanks are only 40 ft. above sea level so there are no serious difficulties involved in the discharge of crude. The marine terminal is of reinforced concrete and stretches 2,400 ft. from Corkbeg into the deeper waters. The jetty is L-shaped.

Processing . . . From the tanks at Corkbeg, crude goes to an atmospheric topping unit (see accompanying flowsheet) designed to produce bottoms suitable for sale as heavy fuel oil. Some of these later cut back in blending to yield medium and light fuel oil. The topping-tower overhead is virgin naphtha which is debutanized and then split into two fractions. The heavier of these is reformed for octane improvement, while the lighter is simply sweetened with $CuCl_2$.

Two side-streams from the topping tower provide heavy naphtha and gas oil. The heavy naphtha is divided and part is taken as blending stock for kerosine-range grades. The other part is added to light naphtha. The catalytic reforming is the conventional Powerforming process which yields a wide range of products from tractor fuel to LPG and other gases.

Initial deliveries of crude from the Middle East arrived in April. The pipe still started up at the end of May and was recently closed down for inspection. The Powerformer came on stream at the end of July, thus making available the full range of products.

1. **GOING INTO** the hole, it is still possible to rotate, circulate, and apply weight.

2. **WITH RELEASE** plug seated, the barrel is ready to cut 2 ft. of core.

3. **WHEN 2 FT.** has been cut, drill pipe is lowered and barrel is ready to cut another 2 ft. of the 20-ft. possible maximum.

New rubber-sleeve core barrel gets good cores

in soft and unconsolidated formations

BY B. L. AUSTIN
Christensen Diamond Products Co.
Salt Lake City

IN EXTENSIVE TESTS in fields of the United States and Venezuela, a new rubber-sleeve core barrel has got high percentages of recovery and excellent-quality cores. As the cores are packaged in the rubber sleeve as they are cut, there is no flushing of the core by well fluids after cutting.

The barrel includes a hydraulic feed joint that acts as an automatic driller and keeps a constant weight on the bit. This same feedoff principle makes possible a mechanism that pulls the rubber sleeve and core up into the core barrel as the core is formed. This feature relieves the core of any compressive loads and eliminates any possibility of wedging the core in the barrel.

What it offers . . . There are many differences in construction and operation between a conventional diamond core barrel and the rubber-sleeve barrel. Outstanding feature of the rubber-sleeve barrel, as the name implies, is that a tight-fitting rubber sleeve encases the core as it is formed. The rubber sleeve, which is pulled into the core barrel at the same rate that the core is formed, acts as a cylindrical conveyor, supporting the weight of the core and transporting it into the barrel.

Because this sleeve is 2⅜-in.-i.d. in its free state and is stretched over a 3-in. core, there is a force similar to the overburden pressure exerted on the core tending to keep it in its original state. Fractured and unconsolidated sections or formations which tend to swell or decompose when in contact with the well fluids are therefore contained so that they will not bridge in the inner barrel and cause the core to be ground up. This compacting force also retains most unconsolidated sand formations in an undisturbed condition with the individual grains remaining in their original orientation.

The rubber-sleeve principle will not provide an absolutely uncontaminated core since invasion of the reservoir by the well fluids may be instantaneous, occurring even before the core is formed. However, packaging of the core immediately after it is cut and isolating it from moving fluids as it is forming does tend to retain the core in the "as-cut" state with much less contamination than is possible by other means. It also reduces to a minimum the bad effects that result from long submersion in well fluids.

An interesting example of this occurred recently in eastern Venezuela. The rubber-sleeve barrel was used to core a section originally described as a "soft - to - mushy" unconsolidated sand. When the cores were recovered, they were found to be quite well compacted, almost firm. Yet when removed from the rubber sleeve and submerged in mud, these cores would decompose rapidly. With this knowledge it is easy to understand the poor-quality cores and low recovery percentages with conventional barrels.

Where it has worked . . . Introduction of diamond core barrels in 1946 at Rangely, Colorado, was a major step toward maximum core recovery under normal well conditions. It has been estimated that conventional diamond core barrels recover in excess of 90% of the total footage that is cored with this equipment. Unfortunately, however, all too often the small percentage of core that is not recovered happens to be the particular section of most interest. Also, many soft unconsolidated sands that are prolific producers have been virtually impossible to recover with conventional core barrels; or, if partially recovered, the cores are too poor to be of value.

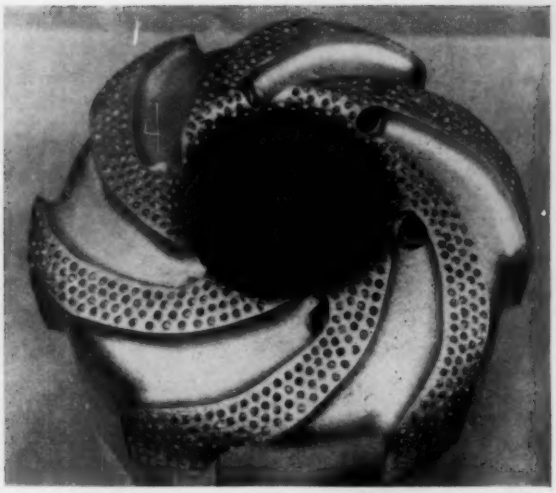
Use of the rubber-sleeve barrel has been limited generally to areas where unconsolidated formations have made recovery with standard barrels unsatisfactory. As shown in Table 1, eastern and western Venezuela; Louisiana; South, East, and West Texas; Oklahoma; Mississippi, and Arkansas are areas in which these barrels have been used recently. In most of these applications it has been possible to recover in the range of 90%. Several of these wells could have been cored satisfactorily with a conventional diamond barrel, whereas others were problem areas where recovery with

From a paper titled, "New Developments in Coring With The Rubber-Sleeve Core Barrel," presented at 1959 meeting of API Division of Production's Mid-Continent District, Amarillo.

Results of use of new rubber-sleeve core barrel. Table 1

Job No.	Location	No. of cores	Total ft. cored	Total recov.	Per cent recov.	Depth interval	Formation cored	Comparative Results
1	Harrison Co. Texas	1	12	11	92	2,390-2,402	Broken lime	Cores satisfactorily with standard diamond barrel.
2	Lincoln Co. Miss.	1	14	12	86	10,800-10,814	Shale	Cores satisfactorily with standard diamond barrel.
3	Lafayette Co. Ark.	1	10	10	100	2,794-2,804	Soft sand	Several extremely soft layers 1 to 3 in. thick recovered. Standard barrel would recover everything except these soft sections.
4	Smith Co. Miss.	1	19	12	63	4,800-4,819	Shale	Would core satisfactorily with standard barrel. Coring here to obtain uncontaminated shale cores for study by mud company.
5	Sterling Co. Texas	16	153	144	94	1,724-1,877	Anahydr. sd., sh.	Much of this section would core satisfactorily with standard barrel but recovery would be slow in soft sand sections.
6	Murray Co. Okla.	1	16	15	94	4,325-4,341	Soft sand	Coring with standard diamond barrel in this area was discontinued because of poor recovery.
7	Beauregard Parish La.	2	38	34	89	6,227-6,350	Sand and shale	Anticipated very soft sands but this could have been cored with conventional barrel.
8	Hardin Co. Texas	4	72	66	92	8,534-8,828	Sand and shale	Recovery fair to good with standard diamond barrel.
9	E. Venezuela (Jusepin)	19	414	340	82	3,638-4,469	Sand and shale	Recovery poor with standard diamond barrel.
10	W. Venezuela (Mene Grande)	10 •	110	106	96	584-694	Tar sand and clay	Almost impossible to recover anything but clay in this formation. Tar sand completely unconsolidated.
11	W. Venezuela (Mene Grande)	7	124	108	87	543-667	Tar sand and clay	Almost impossible to recover anything but clay in this formation. Tar sand completely unconsolidated.
12	W. Venezuela (Mene Grande)	7	126	117	93	575-701	Tar sand and clay	Almost impossible to recover anything but clay in this formation. Tar sand completely unconsolidated.
13	Duval Co. Texas	4	78	69	88	2,410-2,535	Soft sd. and shale	Previously unable to recover with standard barrel.
14	W. Venezuela (Lake Maracaibo)	13	224	119	53	2,160-2,433	Soft sand	Lost most of core from rubber coming out of hole. Poor recovery but much better than any previous experience.
15	E. Venezuela (Jusepin)	16	317	261	82	4,027-4,471	Sand and shale	Recovery poor with standard diamond barrel. Black Magic mud used.
16	E. Venezuela (Melones)	2	40	35	86	3,600	Soft sd. and shale	Previous recovery average 13%.
17	E. Venezuela (Meray)	9	160	137	86	3,625-4,014	Soft sd. and shale	Previous recovery average 13%.
18	Hardin Co. Texas	2	40	36	90	8,680-8,720	Firm sd. and shale	Recovery fair to good with standard diamond barrel.
19	Orange Co. Calif.	12	210	50	25	325-600	Unconsolidated conglom.	Most recovery ever obtained here. No recovery with several other types of barrels. Boulders from 12-in. dia. to pea gravel with soft sand and tar between. Core would not form.
20	Murray Co. Okla.	3	36	36	100	4,300-4,350	Firm sd. and shale	Coring with standard diamond barrel in this area was discontinued because of poor recovery.
21	Placquemines Parish, La.	2	39	31	79	8,458-8,497	Soft sd. and shale	Salt-water-injection well—maximum quality cores required.
	TOTALS		2,198	1,736	79			

ONE STYLE of diamond bit used with rubber-sleeve core barrel. Not usually considered for soft formations, diamond bits have proved quite successful with the new tool. Fig. 4.



ANOTHER STYLE diamond bit used. Footage with these bits has proved high, so that cost per foot has been low in spite of original expense of diamond bits. Fig. 5.

conventional barrels would range from 10 to 60%.

The majority of core that has been lost on these jobs has been the result of two things. One, the rubber sleeve was damaged and parted or, as on job No. 14, the core was simply so soft that it would not remain in the rubber during the trip out of the hole. Work is continuing to eliminate both of these problems.

Details of operation . . . Although the rubber-sleeve barrel is more complex than a conventional diamond barrel, its operation in the hole is trouble-free and, in many respects, simpler than a conventional barrel. When the barrel is being run into the hole (see Fig. 1), it is possible to apply weight, rotate, and circulate as is occasionally necessary to wash out bridges and work through tight spots. Once on bottom with circulation established, the stripper-tube release plug is dropped into the drill pipe and circulated to its seat in the top of the stripper tube. When the release plug is properly seated, as shown by an increase in circulation pressure, the fingers of the stripper-tube latch are spread open, which allows the splined joint to be collapsed its full stroke of 2 ft. (see Fig. 2). At this time, the brake on the draw works is tied down while the splined joint extends and the first 2 ft. of core is cut.

Weight on the bit is provided by the pressure drop developed at the nozzles acting across the area of the splined joint seal. The torque is transmitted by the splined joint. As the bit head penetrates the formation and the splined joint starts to extend, the stripper tube is prevented from moving downward by the top stripper-tube rachet sprint. Consequently, the rubber sleeve, which is attached to the lower end of the stripper tube, is pulled into the lower inner barrel as the bit head and core barrel advance downward over the core. The stripper tube in this manner might be said to pull the rubber and core into the core barrel.

When 2 ft. of core has been cut as shown in Fig. 3, there is an increase in indicated weight on the hook plus a loss of rotary torque. Rotation and circulation are then stopped and the drill pipe is lowered another 2 ft. While this is happening the top stripper-tube ratchet spring is carried down over the stripper tube with the male half of the splined joint. The bottom stripper-tube ratchet now catches the stripper tube and prevents it from moving downward and disturbing the core. In this manner the stripper tube is held stationary in elevation all during the time the core is being cut; and the rubber sleeve, once it has been pulled off the inner barrel, remains stationary with respect to the core that it surrounds.

Run with diamond-set heads . . . In the past, most have not thought that diamond-set core heads are necessary in extremely soft and unconsolidated formations. Much coring in such formations has been done with tungsten carbide-faced drag bits. In fact, this was the only type bit considered when the original rubber-sleeve barrels were run. However, field results soon showed that these unconsolidated sections are seldom massive bodies. Usually they contain at least occasional shale breaks. This fact showed that the tool called for a core head which could:

1. Drill soft sections rapidly.
2. Drill firm-to-hard sections.
3. Have adequate fluid control to avoid washing of soft sands.
4. Drill with light loads.
5. Operate cheaply.

The diamond-set bits presently used with the barrel (Figs. 4 and 5) have more than met these requirements. Diamond bits have the unique ability to retain their shape throughout their full life. This fact solves the problem of fluid control. Drilling rate in both soft and hard formations has been excellent. Two-foot sections have been cored as rapidly as 2 to 3 seconds, while the harder shales have occasionally taken as long as 40 minutes per foot.

The hydraulic feed joint in the core barrel likely accounts for some of the good penetration rates since it automatically feeds off at the proper rate and keeps a constant weight on bit.

Although diamond bits are generally thought of as expensive, footage with them has been high and the final cost per foot has been very good.

The rubber-sleeve core barrel currently available is 6⅞-in. o.d. It recovers a 3-in-diameter core, 20 ft. long. The majority of the work has been using 7½-in. bits although 8⅜-in. bits have been used. A smaller size is near development for the mining industry. This barrel will be 2⅞-in. o.d. and will recover a 1 7/16-in. core, 10 ft. long.

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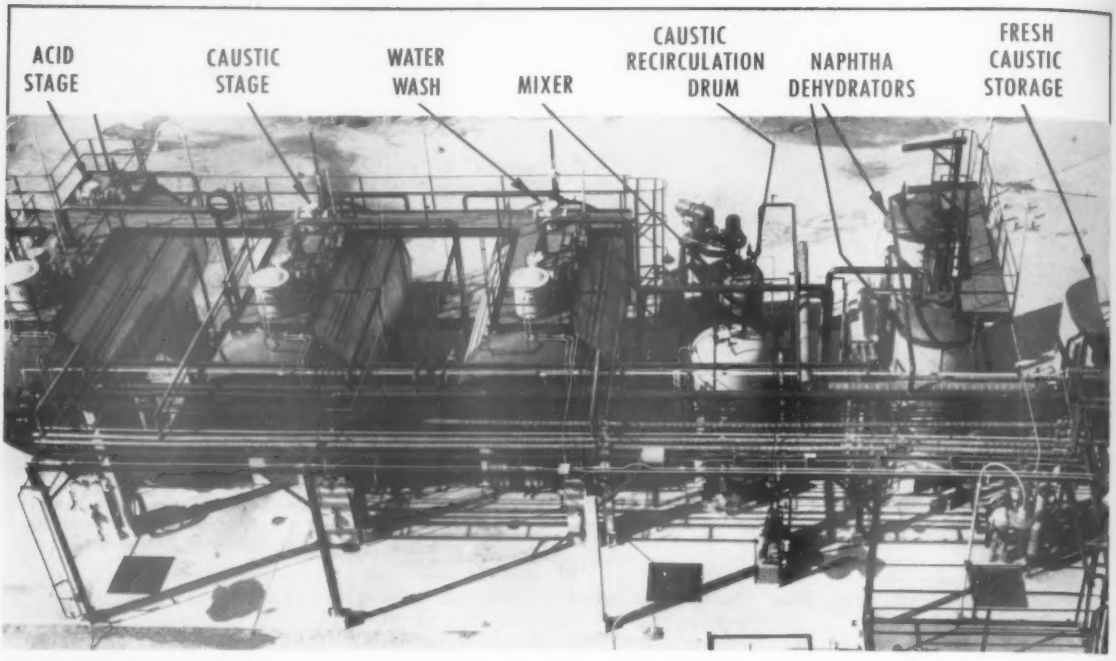


PLANT LAYOUT for electrostatic desulfurizer is neat and compact. Efficiency of sulfur removal has been 80 to 95% since installation.

How first electrostatic desulfurizer has

THE FIRST commercial electrostatic desulfurizer went into operation at the East Chicago, Ind., refinery of Cities Service Oil Co. in October 1958.

This installation represents the initial attempt to desulfurize catalytic reformer feed stock with sulfuric acid. Another unusual feature is that spent alkylation acid is used as the primary treating agent.

Operating experience may be summarized by these results:

- Efficiency of sulfur removal has been in the range of 80 to 95%. The plant has had no difficulty meeting performance guarantees.
- Significant reduction in the amount of trace contaminants such as metals has also been realized.
- The process appears to be economically competitive with other methods of desulfurization.
- The ultimate effect upon platinum catalyst of acid-treating reformer feed stock has not been fully evaluated. The initial run of the reformer was terminated prematurely due to excessive coke in the feed-recycle gas heat exchangers and on the platinum catalyst. The source of the coke-forming materials has not been determined.

Paper presented at WPRA southeast regional meeting, El Paso, 1959.

BY K. C. YOUNGBLUT
Cities Service Oil Co.

Charge and Product

Table 1 illustrates typical inspections of charge and product streams. The design charge to the unit is 8,000 bbl. per stream day of Mid-Continent straightrun naphtha containing 500 p.p.m. or less of sulfur. This stock is the bottoms from a prefractionator and is stored in gas-blanketed tankage prior to desulfurization.

The product naphtha is charged to a fixed-bed reformer using platinum-type catalyst. The degree of sulfur removal is therefore of prime importance. Composite samples analyzed by Cities Service laboratories indicate that the average sulfur levels have been approximately 250 p.p.m. in the desulfurizer charge and 30 p.p.m. or 0.0030 wt. % in the product. Extremes of 90 and 266 p.p.m. have been found in the feed and 7 and 81 p.p.m. in the product.

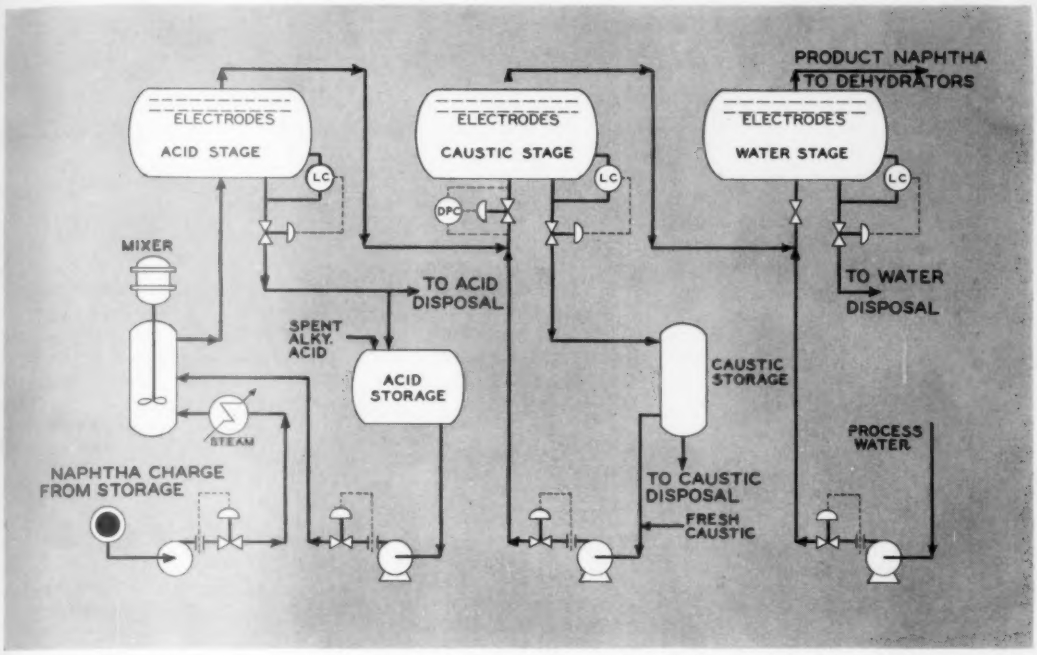
Other impurities reduced . . . The lead content of the feed stock has ranged from 8 to 20 p.p.b. Analyses of the treated effluent have shown that this has been effectively reduced to 0 to 4 p.p.b. Arsenic is present in the charge in quantities of roughly the same order as lead (7 to 13 p.p.b.). Removal has also been comparable to the level of 0 to 5 p.p.b.

Although there has been substantial reduction in lead and arsenic, the sodium in the feed of about 20 p.p.b. has increased through the process to approximately 40 p.p.b. in the dried product. This is very likely due to incomplete removal of carryover caustic in the water wash stage. Water-mixing energy has been increased in an attempt to correct this situation.

The process has had essentially no effect on chloride or nitrogen compounds present in the feed stock.

Process Flow

Fig. 1 represents a simplified flow diagram of the unit. The raw charge is pumped through a steam heat exchanger to maintain the desired processing temperature. It then enters the mixer vessel where it is intimately



FLOW SCHEME for process provides for acid contact, followed by caustic and water washes. Fig. 1.

rizer has performed for Cities Service

combined with the acid by means of a variable-speed mixer.

The naphtha-acid dispersion is next directed to the acid stage or reactor, where it enters at the bottom. In the lower half of this vessel the desulfurization reactions are completed, while in the upper half the suspended acid particles are coalesced for settling by gravity to the bottom. The collected acid containing the reaction products is removed to storage for recirculation or to disposal facilities. The desulfurized naphtha, including up to 100 p.p.m. of insoluble acid, proceeds to the caustic stage for neutralization.

Just prior to entering the caustic precipitator, the naphtha is injected with a stream of sodium hydroxide. Mixing of the two immiscible liquids is realized by virtue of a pressure drop through a partially closed control valve. Neutralization of entrained acids is accomplished in the bottom of the caustic stage and coalescence of the caustic droplets takes place in the upper portion. Suspended caustic carryover has averaged about 5 p.p.m.

During a particular 4-day period it was necessary to operate the unit with no electric power on the neutralization stage. In spite of this abnormal condition the carryover did not exceed 15 p.p.m.

Water wash . . . The hydrocarbon is next subjected to a water wash. Mixing is effected by a partially closed globe valve and the separation of the two phases is again performed electrically. The water content of the effluent is in the order of 100 to 150 p.p.m.

The final phase of the process is drying of the previously desulfurized, neutralized, water-washed product. Parallel dehydration vessels permit a continuous drying-reactivation cycle. Containing less than 40 p.p.m. of water, the naphtha flows to a gas-blanketed surge drum for subsequent processing in the reforming unit.

Although not shown on the flow diagram, purge oil is employed to prevent the accumulation of the conductive treating agents in the electrical insulator housings. This flushing medium is dried naphtha product pumped at a total rate of about 16 g.p.m. into various connections on the electrical equipment. The purge then joins the main stream of naphtha being processed.

Electrostatic mixing . . . The licensors of the electrostatic desulfurization process, Howe-Baker Engineers, Inc., attribute much of the high level of sulfur removal to a technique described as "electrostatic mixing." This phenomenon employs electrical energy to impart a rapid, random motion to the dispersed acid particles. The accelerated movement thus produced enhances the completion of the desulfurization reactions and increases the degree of phase separation, the latter by utilizing "electrostatic precipitation."

The major reactions involved in the desulfurization process consist of the oxidation of the various sulfur compounds in the feed to the disulfide form. These materials, being preferentially soluble in the acid, are removed from the system with the spent acid. Although some of these reactions take place during the course of mechanical mixing, increased reaction efficiency is realized in the acid stage as described previously.

"Operating costs are nominal due principally to the utilization of spent alkylation acid. Cost of unit was about $350,000."

The equipment used in this unit is all of standard design with the exception of the mixer and the electrical system. The purpose of the mixer is to reduce the acid to a uniform particle size which is the optimum for both reaction efficiency and phase separation. For this reason, a specialized turbine-blade mixer is used.

In order to realize to the maximum the effect of the electrical energy for reaction and separation, careful design and orientation of the electrode system is essential. Carbon-steel piping and vessels have been used throughout. However, data and experience to date indicate that minor amounts of alloy may be required to counteract localized corrosion.

Chemicals Used

Spent alkylation acid is employed in this unit because of its availability and the nominal operating cost incurred. The strength of this acid averages 88 to 91 wt. % and the quantity available varies from 90 to 200 bbl. per day, depending upon the relative amounts of propylene and butylene being alkylated. A gas-blanketed drum at the desulfurizer permits acid recirculation within the unit when quantities are limited or when using fresh acid during alkylation unit shutdowns.

Normally, the acid is used on a once-through basis, in which case the reduction in strength amounts to 10 to 15 wt. %. This material is returned to the acid manufacturer for recovery. Fresh 99% acid has been used, but no significant changes in desulfurization characteristics were noted.

Fresh 12° B. caustic is stored at the unit and is used to replace the circulating caustic when spent. Replacement takes place when the strength has been reduced to about 2 wt. %. A gas-blanketed drum is included in the circuit for recirculation. A once-through system is under investigation in an effort to minimize the amount of operating labor required by the present system. Caustic consumption has been significantly greater than anticipated due principally to the presence of acidic hydrocarbon complexes in the acid stage effluent.

Since these materials are not present in the raw charge, it is assumed that they either solubilize in the naphtha from the spent alkylation acid or are formed in the desulfurization process. Present rates of caustic usage require that the circulating inventory be changed every 20 to 24 hours, which represents an average consumption of about 0.25 lb. of sodium hydroxide per barrel of naphtha feed.

The process water is pumped from the refinery cooling-water system. Due to the nature of this water, pretreatment is not required.

The final step of the processing scheme, the naphtha dehydrator, is filled with activated alumina desiccant. Hydrogen-rich product gas from the reformer unit is utilized as the reactivating agent.

TABLE 1—TYPICAL CHARGE AND PRODUCT INSPECTIONS

	Charge	Product
Gravity, °API	57.8	57.8
Color	30	30
Distillation, ASTM, °F.:		
I.b.p.	188	188
10%	212	209
50%	250	252
90%	328	331
E.p.	380	382
Type analysis, vol. %:		
Paraffins	50.9	50.1
Naphthenes	43.9	44.5
Aromatics	5.2	5.4
Sulfur, p.p.m.	238	28
Lead, p.p.b.	13	3
Arsenic, p.p.b.	12	5
Sodium, p.p.b.	20	40
Chlorides, p.p.m.	2.5	2.2
Nitrogen (basic), p.p.m.	0.1	Nil
Nitrogen (total), p.p.m.	0.3	0.1

TABLE 2—TYPICAL OPERATING DATA

Charge:	
Rate, B/D	8,000
Temperature, °F.	80
Acid stage:	
Acid circulation, B/D	120
Acid strength in, wt. %	90
Acid strength out, wt. %	76
Mixer speed, r.p.m.	85
Pressure, psig.	60
Temperature, °F.	82
Purge oil, g.p.m.	4
Electrical potential, volts	20,000
Electrical current, ma.	<1
Caustic stage:	
Caustic circulation, B/D	240
Mixing-valve pressure drop, psi.	22
Pressure, psig.	35
Temperature, °F.	84
Purge oil, g.p.m.	8
Electrical potential, volts	20,000
Electrical current, ma.	<1
Water stage:	
Water circulation, B/D	800
Mixing-valve pressure drop, psi.	10
Pressure, psig.	23
Temperature, °F.	76
Purge oil, g.p.m.	4
Electrical potential, volts	20,000
Electrical current, ma.	<1

Operating Experience

Table 2 summarizes typical operating data. Temperatures are maintained in the ambient range of 80° to 100° F. in order to minimize undesirable side reactions such as esterification and sulfonation. The pressure level is determined, to a great degree, by the magnitude of the pressure drop across the caustic and water mix valves. This drop is, in turn, dictated by the amount of mixing energy required to effect complete neutralization and washing without inhibiting coalescence.

Operating difficulties have been confined primarily to the caustic stage. Conductive materials, presumably the products of saponification reactions, have deposited on the insulators causing short circuits in the electrical system. However, improved purging of the insulator housings has apparently solved this problem.

Corrosion, also, has been most pronounced in the caustic wash system. The presence of weak acids, probably due to the complete expenditure of the caustic in the circulating system, has resulted in physical failure of portions of the electrode system on two occasions. Severe corrosion has also occurred in the piping where the caustic stream joins the acid stage effluent, as well as in the body of the caustic mix valve. A recent turnaround inspection further revealed that a combination of corrosion and erosion had severely attacked the shell and internals of the acid mixer vessel.

Economics

The erected cost of a unit of this size is about $350,000.

Operating costs are nominal due principally to the utilization of spent alkylation acid. Were this material not available, additional cost for fresh acid would be incurred. The caustic consumption rate mentioned previously represents an expense of roughly $60 per day, whereas process water is available, in this case, for only the pumping cost. An additional debit must be included for product losses of 0.5 to 0.6 vol. %.

The equipment comprising this unit, including the dehydrator, requires one operator per shift. Except for repairs necessitated by corrosion damage, maintenance has not exceeded that which would be anticipated for a new process.

A look at ethylene glycol today

Estimated U. S. production of ethylene glycol in 1958 was nearly 1.2 billion pounds. Of this total, approximately 120 million pounds was produced from formaldehyde plus carbon monoxide. The remaining 90% of ethylene glycol output was obtained by the hydration of ethylene oxide.

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UNAVOIDABLY, the conversion of ethylene oxide to its glycol is accompanied by the formation of higher polyhydric alcohols, notably diethylene glycol and triethylene glycol. While markets for these byproducts have been developed, their formation constitutes a downgrading in value and attempts are made to minimize their yield. For 1957, production of the three main chemicals obtained by hydration of ethylene oxide has been reported as follows: Ethylene glycol 1,200 million pounds (this includes the roughly 120 million pounds produced from formaldehyde); diethylene glycol 113 million pounds; triethylene glycol 25 million pounds.

Growth of Ethylene Glycol

Few petrochemicals can match the growth experience of ethylene glycol itself. Since 1951 its output has doubled, rising from 597 million pounds to 1.18 billion pounds in 1958. In almost every instance glycol manufacturing facilities are built and operated in conjunction with ethylene oxide production. Construction activity in this area has been at high level during the last decade, and capacity now in existence or under construction is well in excess of glycol requirements. Following is the expected lineup of ethylene glycol capacity as of late 1959.[1,2]

Manufacturer—	Million pounds per year: Ethylene glycol cap.	Million pounds per year: Capacity based on ethylene oxide*
Allied Chemical	35	43
Calcasieu Chemical	75	73
Dow Chemical	350	340
Du Pont	150	...
General Aniline & Film	35	73
Jefferson Chemical	180	207
Olin Mathieson Chemical	100	122
Union Carbide Chemicals	750	810
Wyandotte Chemicals	90	110

*Amount of ethylene glycol which could be produced if all ethylene oxide capacity were devoted to this purpose.

Hydration capacity . . . The extent to which each manufacturer provides hydration capacity for his ethylene oxide plant depends primarily on his individual market outlook. For while ethylene glycol constitutes by far the most important consumer of ethylene oxide, other end uses are taking up an increasing share of ethylene oxide output in the U. S. Thus, the end-use pattern for ethylene oxide during the decade 1955-65 has been estimated as follows:

End use	Consumption, % of ethylene oxide: 1955	1960	1965
Ethylene glycol	64	61	58
Nonionic surfactants	10	11	15
Ethanolamines	7	10	10
Polyethylene glycols	9	8	8
Acrylics	6	6	5
Other	4	4	4

Ethylene glycol and polyethylene glycols are the products germane to the present discussion for both are formed in the course of ethylene oxide hydration.

Markets for Ethylene Glycol

Throughout its remarkable growth period, ethylene glycol has found its principal outlet as antifreeze. While this market continues to grow at a rate of about 3% per year, its percentage share of the total glycol market is on the decline as faster-growing consumers—notably polyester resins and fibers—take on more significance. Thus, ethylene glycol end-use distribution in the U. S. appeared as follows[3,4] during two recent years:

End use	% of glycol consumption: 1956	1958
Antifreeze	83	75
Cellophane	2.4	3.8
Explosives	2.8	3
Fibers and film	1.0	2.5
Alkyds and ester gum		2
Electrolytic condensers	0.4	0.5
Exports	5.5	7.5
Dealers and distributors	0.4	1
Miscellaneous	4.5*	4.7

*Includes polyester fibers.

All told, the market for ethylene glycol rose from 367 million pounds in 1948 to 880 million pounds in 1958.

Antifreeze . . . In the antifreeze field, much of ethylene glycol's growth has come about by displacement of nonpermanent antifreeze types. In 1957, total antifreeze sales in the U. S. were estimated at 102.8 million gallons of which 81.6 million gallons were ethylene glycol type. Continued growth of glycol consumption in this market is forecast at 3% per year. On the basis of 15% reuse, ethylene glycol sales for antifreeze purposes is thus anticipated to be 125 million gallons (1.15 billion pounds) by 1965[5].

Other uses . . . No other single market for glycol comes even close to use as antifreeze. Three uses share second place: application as softening agent for cellophane (45 million pounds in 1958), intermediate in the production of low-freezing-point dynamite (30 million pounds in 1958) and raw material in the manufacture of polyester fibers and films.

Polyester fibers . . . Of these three outlets, important growth is anticipated only in polyester fibers. Included in this group is Du Pont's Dacron and Fiber Industries' Teron. Upon completion of construction projects now under way, U. S. Dacron capacity will be 100 million pounds per year. Three other polyester fiber projects, consuming ethylene glycol, have been announced with a combined capacity of 60 million pounds per year.

Downward pressure on the short-term glycol market is exerted by the loss of at least part of the foreign market to European plants which will

soon come on stream. A decline is also noted in the use of nitrated ethylene glycol in explosives and manufacture where it is being replaced by lower-cost ammonium nitrate.

Beyond these itemized outlets for ethylene glycol, there exists a host of minor applications, which are of significance in their cumulative impact.

Outlets for Polyethylene Glycols

Unavoidably, the hydration of ethylene oxide yields higher polyethylene glycols as coproduct. Formation of these byproducts can be varied to some extent by adjustment in operating conditions.

Higher glycols . . . Typically, the two commercial higher glycols, diethylene glycol and triethylene glycol, are formed in a ratio of about 10:1 and their combined yield constitutes 11-13% of glycol output. Total U. S. output in 1957 was 112.7 million pounds DEG and 25.1 million pounds TEG. This compares with a production of about 1,080 million pounds ethylene glycol from ethylene oxide during the same year.

Markets for these higher glycols of ethylene have developed at moderate pace. Historically, serious marketing problems for these products have occurred during periods of rapid expansion in ethylene glycol output. Especially during such times, formation of the higher glycols represents a downgrading in the value of contained ethylene oxide.

Most of the market for **diethylene glycol** exists in six major areas[6,7]:

1. In the textile industry, as solvent for dyestuffs, as coupling agent in emulsifiable oils used for various textile operations and as hygroscopic conditioning agent for natural and synthetic fibers prior to warping and spinning;
2. As a component in antifreeze mixtures.
3. As co-solvent in the Udex process for extracting aromatic hydrocarbons from catalytic reformate.
4. In the manufacture of printing inks.
5. As dehydrating agent for natural gas.
6. As plasticizer for paper coatings.

Triethylene glycol serves as plasticizer (notably for resin binders in composition cork), as gas-dehydrating agent, and as air-purifying and disinfecting agent.

In addition, **both glycols** are used as intermediates in a number of chemical syntheses, e.g., diethylene glycol is converted to esters of lauric acid, oleic acid, and stearic acid which are used as surface-active agents.

Technology of Ethylene Oxide Hydration

The conversion of ethylene oxide to ethylene glycol takes place in accordance with Equation 1:

$$H_2C-CH_2 + H_2O \rightarrow HOCH_2-CH_2OH \quad (1)$$

ethylene oxide + water → ethylene glycol

Liquid phase commercially . . . The reaction may be carried out in either the liquid phase or the vapor phase. Commercial technology is confined to liquid-phase conversion, employing either dilute (app. 1%) aqueous sulfuric acid or noncatalytic reaction with water at elevated temperature and pressure. Both techniques have shortcomings, but they are characterized by relatively good yield and suitability for ready integration into an ethylene oxide plant.

More recently, liquid-phase hydration has been developed (on an experimental scale) to include catalysis by acid ion exchange resin suspended in aqueous medium.

Various advantages have been claimed for the hydration of ethylene oxide in the vapor phase, using such catalysts as silver oxide and various ion-exchange resins. Results on considerable laboratory work of this character have been reported.

It will be the purpose of the remaining discussion to examine the various major types of technology which are in industrial operation or which have found extensive laboratory development in the field of hydration of ethylene oxide to its glycol.

Liquid-Phase Techniques

1. Reaction mechanism . . . Ethylene oxide hydration at low temperature has been investigated by Long and Pritchard.[8,9] These investigators concluded that the main conversion takes place in three stages, to wit:

$$CH_2-CH_2 + H^+ \rightarrow CH_2-CH_2 \quad (2a)$$
$$\quad O \qquad\qquad\quad OH^+$$

very fast rate

$$CH_2-CH_2 \rightarrow {}^+CH_2-CH_2OH \quad (2b)$$
$$\quad OH^+$$

slow rate

$$CH_2-CH_2OH + H_2O \rightleftarrows (CH_2OH)_2 + H^+ \quad (2c)$$

fast rate

In this mechanism, Reaction 2b is the rate-controlling step and the hydration may be expected to be essentially a first-order reaction, controlled by concentration of the protonated substrate of thylene oxide.

More recently, Othmer and Thaker[10] have reported on the kinetics of the reaction at 30°-50° C., using very dilute ethylene oxide solutions. At these conditions, the reaction is found to be first-order with regard to ethylene oxide concentration (C), following the relation:

$$\log C = -Kt + \text{constant}$$

In this last equation, the reaction velocity constant K increases with hydrogen-ion concentration. A straight-line relationship is obtained when log K is plotted vs. hydrogen-ion concentration. Thus, a quantitative basis is provided for the two liquid-phase hydration processes which are practiced commercially: Conversion at high temperature (200° C.) and hydration in the presence of acid catalyst.

Less completely explored is the mechanism by which the higher glycols are formed. Hamilton and Metzner[11] suggest, by inference, that two main steps are involved, starting from the protonated substrate of ethylene oxide formed in Reaction 2b:

$$H_2C^+-CH_2OH + (CH_2OH)_2 \rightleftarrows \begin{matrix} H_2C^+-CH_2OH \\ | \\ HOCH_2-CH_2OH \end{matrix}$$

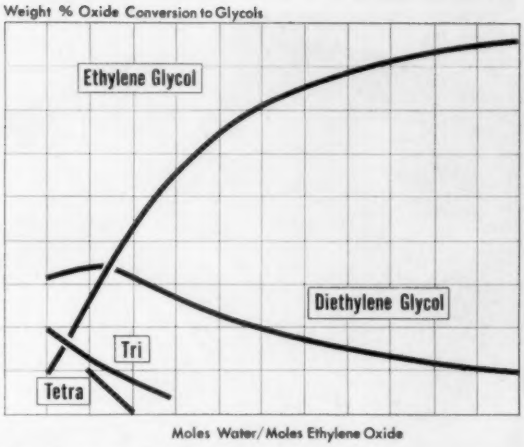
$$\rightleftarrows O(CH_2CH_2OH)_2 + H^+ \quad (3)$$

Both of these postulated reactions occur rapidly and compete with Reaction 2c. Key to the relative importance of these two competitive reaction systems is the relative concentration of water and glycol, i.e., maximum glycol yield may be expected in dilute solution.

Such low concentration of glycol may, of course, be brought about in

one of two ways: (1) low conversion per pass and (2) a high ratio of water to ethylene oxide in the feed. The former approach is commercially not practicable—the liquid-phase hydration of ethylene oxide is carried out in single pass. It is, however, quite feasible (within economic limits) to adjust the ratio of reactants in order to influence the extent to which the higher ethylene glycols are formed.

The quantitative influence of this variable has been reported by Matignon[12] and is shown as Fig. 1.



EFFECT OF REACTANTS RATIO on product composition. Fig. 1.

2.—Acid-catalyzed hydration technique . . . In commercial practice of this technique, the catalyst is sulfuric acid in a concentration of approximately 0.5-1.0 wt.%. This acid is reportedly more effective than, say, HCl. Thus, Balcar[13] reports that the hydration of ethylene oxide in aqueous medium containing 0.5 wt. % H_2SO_4 may be effected at 50°-70° C. in less than 30 minutes. The same degree of conversion may be accomplished in the presence of 0.5% HCl at 100° C. in about 20 minutes.

Because operation is feasible at essentially atmospheric pressure, acid-catalyzed hydration may be practiced simultaneously with ethylene oxide recovery from dilute reactor gas. The dilute gas is fed to the bottom of a packed absorption column in which it is contacted with a circulating aqueous solution containing 0.5-1.0% sulfuric acid. Temperature of the system is maintained at 50°-70° C. (note that the hydration of ethylene oxide is an exothermic reaction). Ethylene glycol concentration in the liquor is allowed to build up to 10-12%.

The glycol-rich liquor withdrawn from the absorber bottom must be neutralized—either by addition of a base or by use of an ion-exchange resin.

Lime may be used at the neutralization stage to precipitate calcium sulfate which can be filtered from the dilute aqueous glycol solution. There remain, however, some unprecipitated organic sulfuric acid compounds which are separated only during the subsequent evaporation and distillation and cause charring and product contamination at this stage.[14]

If sodium hydroxide is used for neutralization of sulfuric acid, the resulting sodium sulfate will be precipitated in the subsequent evaporative concentration of glycol. In order to prevent fouling of the heat-transfer surfaces at this stage, it is necessary to circulate the glycol solution through an external salt strainer. Salt accumulating on the strainers is centrifuged to recover entrained glycol.

The main stream of essentially salt-free concentrated (85-90%) glycol is upgraded by vacuum fractionation in which 99% product is taken off overhead.

The tendency to salt precipitation in the evaporators is reportedly[15] avoided by feeding the crude glycol solution to a distillation column together with inert compounds which have a slightly higher boiling point than the glycol and a specific gravity less than the precipitated salt. Thus the addition of 400°-500° F. kerosine is stated to keep the salts in suspension during the primary distillation step.

More recently, the use of ion-exchange resins for the neutralization step has been proposed[16] in order to eliminate the troublesome salt problem. Among resins stated to be effective for the neutralization step is Amberlite 1 R-4, a condensation product of aniline with formaldehyde, and Anex a melamine-formaldehyde condensation resin. In work reported to date, it was, however, found necessary to dilute the glycol solution formed in the hydration reactor.

3. Noncatalytic hydration . . . The alternative industrial technique for ethylene oxide hydration involves the liquid-phase reaction with water in the absence of a catalyst. In this method, commercially feasible reaction rate is attained by operating at high temperature and correspondingly high pressure in order to maintain liquid-phase conditions.

Compared to acid catalysis, thermal liquid-phase hydration has the advantage of less-corrosive conditions and the elimination of the steps required for neutralizing catalyst and removing the resultant salts from the crude product. Offsetting these benefits at least in part, are the following drawbacks of thermal hydration: lower ethylene glycol yield, need for high-pressure equipment, and compression costs if the hydration step is to be combined with the recovery of ethylene oxide from dilute ethylene oxide reactor gas. More commonly, in this technique, ethylene oxide is removed from the oxidation gases by water absorption to a final concentration of 2-3%. Ethylene oxide is then stripped from this liquor and the overhead product is fed to the hydration stage.

Process flow in the thermal hydration step is straight-forward. The following description, covering one commercial unit, is typical:

Liquid ethylene oxide and water are pumped to 330 psig. and are mixed in a volumetric ratio of 1:6. The combined stream, leaving the mixing chamber at about 20° C., is preheated to 120°-160° C. in exchange with converter effluent. The process stream then enters the bottom of the hydration reaction which is essentially a vertical cylindrical tower filled with Raschig rings.

Even in the thermal-hydration method, the reaction liquor must be slightly acid—a pH of 5 is considered adequate. Usually enough impurities are present, in the primary ethylene oxide fed to the hydration converter, to achieve this acidity. However, it is sometimes necessary to feed enough phosphoric or sulfuric acid to achieve a pH of 5 at the point of entry into the hydration converter.

Temperature in the reaction tower is maintained at 190° C. at the bottom, 200° C. at the top. Apparent contact time is 30 minutes, calculated on the empty reactor volume. The exothermic reaction is thermally self-sustaining; in fact, some indirect cooling must be provided in the reactor.

To initiate the reaction when the unit is taken on stream, live steam is

Congrats and $25 for this quip to M. H. Barber, Continental Oil Co., Big Spring, Texas.

"told him to pack the pump"

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injected into the bottom of the reaction tower.

The overflow from the converter passes to the feed heat exchanger which it leaves at 95°-105° C. It is then let down to atmospheric pressure.

The glycols solution is adjusted to pH 7 by addition of caustic soda and is concentrated in a three-stage evaporator from which the water (containing up to 1% glycol) is recycled for the conversion stage. The concentrate leaving the evaporator contains 15% water and 85% mixed glycols and is upgraded in a train of four vacuum fractionation columns.

At the conditions described above, the mixed glycols have a composition of 86% glycol, 11% diglycol, and 3% triglycol. Changes can be made in product composition—and thus in ethylene glycol yield, principally by adjusting the ratio of ethylene oxide to water in the feed, as shown in Fig. 1.

4. Developmental liquid-phase processes . . . Each of the commercially practical hydration processes has its individual drawbacks. Thus, the acid-catalyzed method calls for corrosion-resistant construction materials and creates a product—purification problem, while thermal hydration requires the use of pressure equipment. Both methods, moreover, cause significant conversion to higher, less-marketable glycols.

Several attempts have been made to sidestep these problems by choice of different catalysts for liquid-phase hydration. Interest attaches to the use of acid ion-exchange resins. These materials are insoluble and readily filtered. They are relatively noncorrosive. Yet, free hydrogen ions at their surface impart acidic properties to the reaction liquor in contact with this area.

Using strong cation and anion-exchange materials, Reed et al.[21] were able to carry out the hydrolysis at conditions which assured the presence of both vapor and liquid-phase in the system. For a water:ethylene oxide mole ratio of 10:1, glycol yield of 80% was realized, and yield as high as 85% is reported at higher ratios of reactants. Operating temperature should be about 115° C., with a corresponding pressure of approximately 20 psig.

Othmer and Thaker[10] have recently reported hydration results obtained with the ion exchange resin Amberlite IR-120. In the 20°-50° C. range, glycol yield compared favorably with sulfuric acid catalysis at the same reactants' ratio. Up to an ethylene oxide: water ratio of 1:5, glycol yield in the presence of Amberlite exceeded

performance with sulfuric acid by 12 to 15%. This advantage declined somewhat with increasing temperature but was still noticeable at 100° C.

Othmer estimates that a 10-cu. ft. bed of resin at 100° C. can convert 50 million pounds per year ethylene oxide to glycols. At 50° C. the same capacity is achieved with a resin volume of 60 cu. ft. but somewhat higher yield of ethylene glycol is achieved at the lower temperature.

The ethylene oxide:water ratio is also the key variable in determining ethylene glycol yield when dealing with ion-exchange resin catalysis. Formation of very high glycols has an adverse effect on catalyst life so that for this reason, as well, an ethylene oxide:water ratio less than 1:5 is called for.

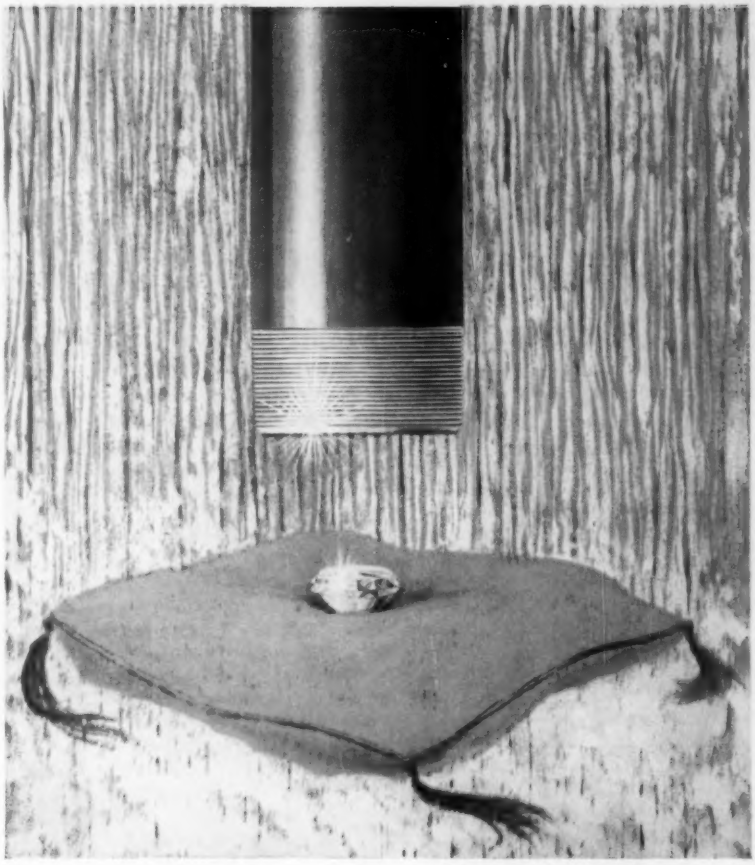
A number of other catalysts for the hydration of ethylene oxide are described in the literature. Reynhart[14] describes the use of iron compounds, while Othmer[10] refers to the catalytic use of silicon oxide, zinc dust, disodium hydrogen phosphate, silver oxide, etc. A completely different course is proposed by Davis[17] who reacts ethylene oxide with aqueous HCl to form ethylene glycol plus ethylene chlorohydrin. The latter compound is reconverted to ethylene oxide by dehydrohalogenation in the presence of lime.

5. Vapor-phase techniques . . . The same considerations which have led to the search for new liquid-phase catalysts have been responsible for work on the hydration of ethylene oxide in the vapor phase.

Pioneer work in this field is due to Cartmell et al.[18] who were able to hydrate ethylene oxide in the vapor phase over silver oxide on an alumina carrier. Conversion to glycol was in the range between 20 and 30%; yield was reported at 80%. Typical operating conditions are 170°-172° C; steam-ethylene oxide molal ratio of 13.5; and contact time of 1.8 seconds. Under such conditions, essentially no glycol formation was catalyzed by phosphoric acid, silica gel, alumina, thoria, and metallic silver.

More recently[19], Pye has claimed 90% conversion and 99% yield in the vapor-phase hydration of ethylene oxide over calcium copper phosphate catalyst. Reactants' ratio, H_2O:EtO, was 6.4 and contact time was 9.4 seconds at 295° C. Essentially no formation of polyglycols is claimed.

Results have been reported[20] for the use of ion-exchange resins as catalysts in the vapor-phase hydration of ethylene oxide. It is indicated that strongly acidic ion-exchange resins are much more active catalysts for this



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reaction than are weakly acid resins. Product distribution depends markedly on mass flow rate through the catalyst bed but is nearly independent of the ratio of steam to ethylene oxide in the feed stream. Actually, Hamilton's work[20] led to the predominant formation of higher glycols in the vapor-phase hydration of ethylene oxide catalyzed by ion-exchange resins. The data suggest, however, that yield of ethylene glycol can be improved substantially by variation in catalyst and in operating conditions.

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Next week . . . How

World's Largest Water Flood

is to be carried out at California's Wilmington field.

What's the optimum refinery size?

BY W. L. NELSON
Technical Editor and Petroleum Consultant

In some of your cost articles you show quite different costs for major refiners and for small refiners. How can you draw the line between independents and majors, and what is the optimum refinery size for each group? M. T. L.

It is obvious that the distinction between majors and independents is a general one. However, the terms are used continually and they do have some meaning.

One of the main reasons for the higher operating and construction costs of major refiners is the position that they occupy in the mind of the public, the union organizer, the trust buster, etc., and because of this position, the so-called major refiner must maintain public relations, must be generous with fringe benefits, and must maintain an organization at the capital.

One can classify oil-company organizations by consideration of these several factors. These and other difficulties tend to overcome the advantages attributed to size by economic theory. Fig. 1 shows the sizes of refineries operated by the so-called majors and the so-called independents. The average refinery size during 1958 was 30,800 bbl. per day; those operated by independents had an average capacity of 9,170 bbl. per day and by the majors, 65,250 bbl. per day. However, most of the smallest refineries of the major oil companies must be by managements that have the psychology of the independent because such refineries would otherwise operate at a loss.

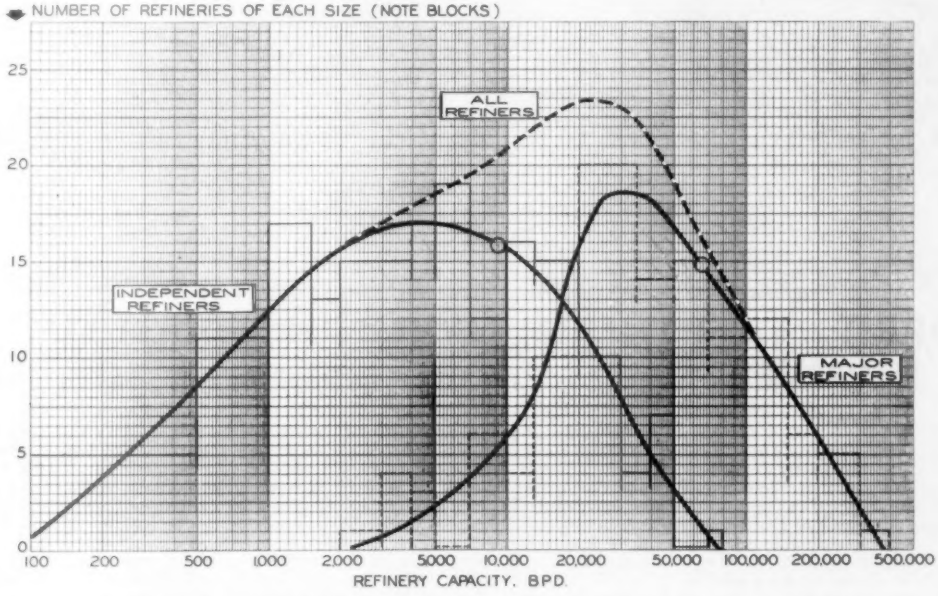
Some of the refineries that were classified as having the independent type of management are actually managed much the same as by a major type of management, especially the lubricating-oil refineries and those operated by cooperatives.

After considering all of these variations, it appears that about 75% of the refinery capacity of the United States is operated by managements that have the policies and psychology of the major operator. Fig. 1 is not proof of optimum size, but it does indicate what sizes were proving to be reasonably economical until such time as enlargements could be undertaken.

Major operators appear to need a refinery capacity of about 10,000 bbl. per day in order to function profitably and the size used most widely during 1958 was about 30,000 bbl. per day. Meanwhile, many independents were operating at capacities under 3,000 bbl. per day and the most common size was about 4,000 bbl. per day. Undoubtedly, both types of refiners would prefer larger plant sizes than those then in operation, probably ranging from 20,000 bbl. (independents) to above 70,000 bbl. (majors).

The large number of specialty plants by independents tends to lower the average capacity of this group but scarcely any such effect is noted among the majors. Obviously, the optimum refinery size is greatly dependent on the kind of processing that is conducted. If catalytic cracking is contemplated the minimum refinery size is not under 12,000 bbl. per day whereas if asphalt specialties are the major product, a size of even 1,000 bbl. per day may be adequate.

Size is not of much importance (as such) to major refiners because large refineries are usually composed of many process units that are only duplicates of others.



APPROXIMATE DISTRIBUTION of size of refineries in the United States. Fig. 1.

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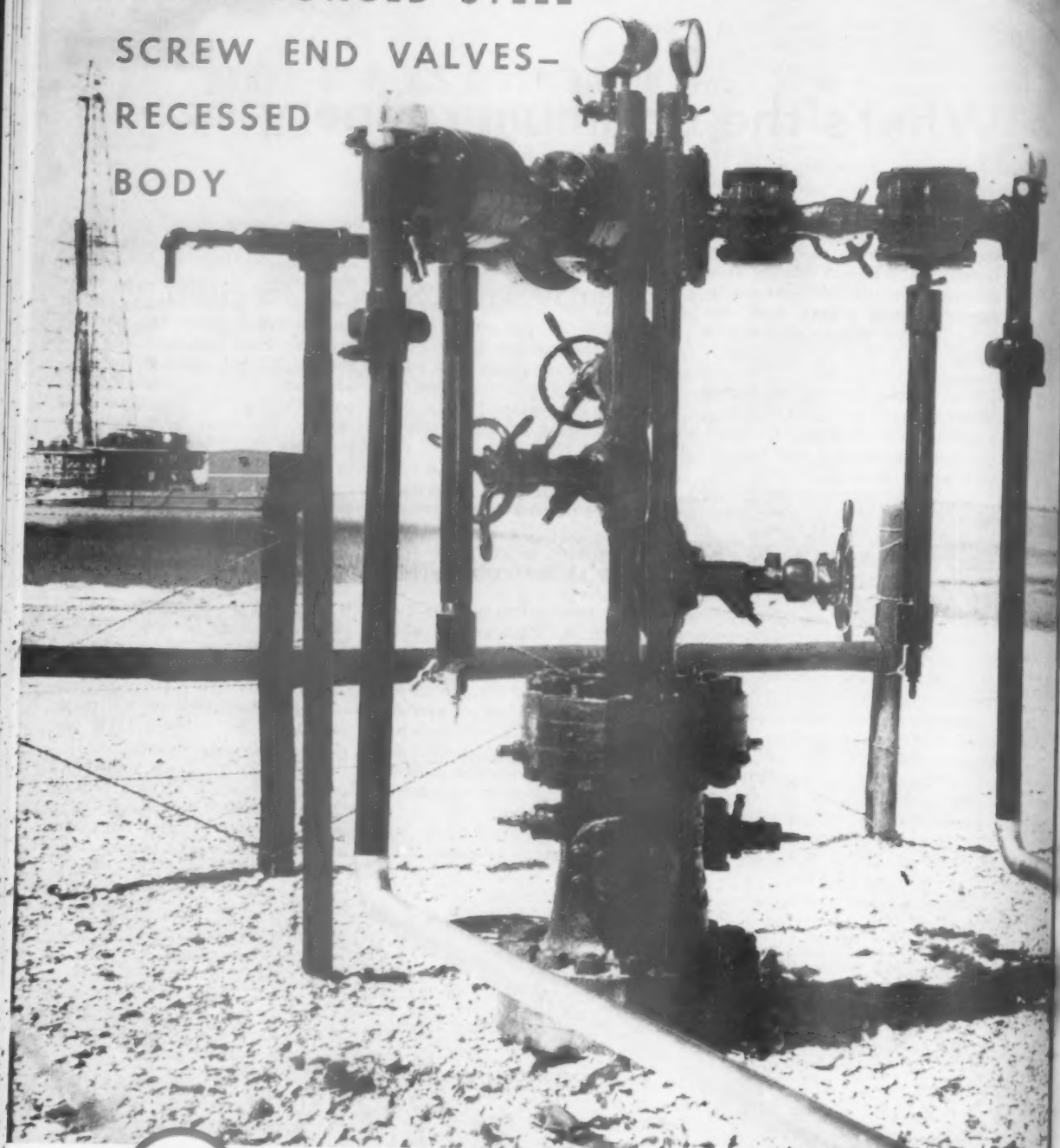

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How fluid-property variation
in a high-relief oil field affects

Material-balance calculations

Accuracy of reserve calculations depends on recognition of property variation with elevation. Studies show that the saturation pressure-elevation relationship is the most critical factor in reserve estimates.

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Senior Petroleum Engineer,
Kuwait Oil Co. Ltd.

PHYSICAL PROPERTIES of fluids vary with elevation in a single oil reservoir, Sage and Lacey in 1939 did some theoretical work predicting changes in the physical properties with structural position.[1] Since then several authors have noted increasing fluid densities with depth, particularly on high-relief pools.

The purpose of this article is twofold: (1) to show, using a hypothetical reservoir, how the fluid properties might vary with elevation based upon published data; (2) to calculate the effect these variations would have in a material balance type of reserve estimate.

Almost all of the work done to date on small reservoirs involved the use of a single PVT. For most of the cases the errors in using a single or average PVT in estimating oil and gas reserves by material balances are probably small. But for some the errors could be large and may explain why many material-balance calculations have given erroneous results.

The hypothetical reservoir used in showing the variation in the physical properties of the fluids is one having a total relief of 1,000 ft. All PVT data were determined by applying the physical properties to Standing's empirical PVT correlations for mixtures of California oils and gases.[2]

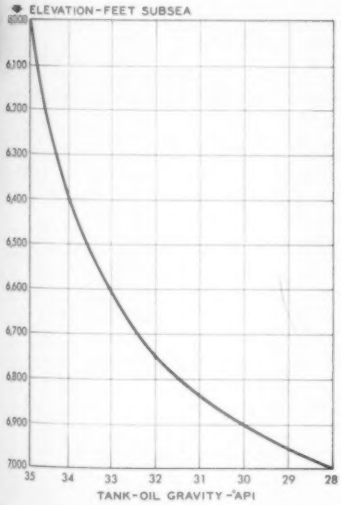
Distribution of Fluid Properties

Probably the first complete reservoir analysis which considered a changing PVT with elevation is the one presented by D. R. McCord[3] on the performance predictions of the LL-370 area, Bolivar Coastal field, Venezuela. It is shown in his paper that the oil gravity varied between 18° and 28° API over 1,500 ft. of closure for an average gravity change of about 0.7° API per 100 ft. of elevation.

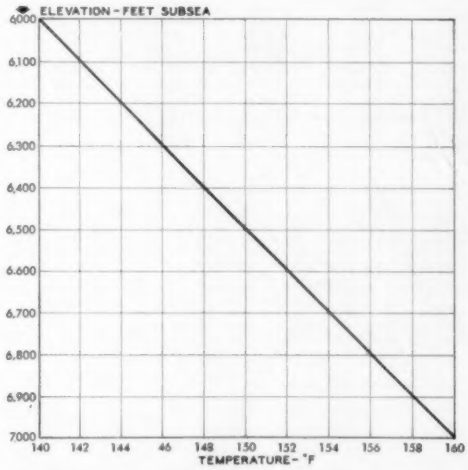
In the fifth zone of Newhall-Potrero field in California there occurred a variation of tank-oil gravity from 25° to 39° API within a closure of 2,000 ft.[4] The average change in API gravity over the range of closure in this field was 0.7° API per 100 ft., which agrees with the variation found in Bolivar Coastal field.

The initial saturation pressure in the Weber sand of Rangely field in Colorado varied from 2,560 to 1,960 psi. over 840 ft. of relief[5] for an average saturation pressure change of about 71 psi. per 100 ft. of elevation. Similar variations have been found in the large Burgan field in Kuwait.

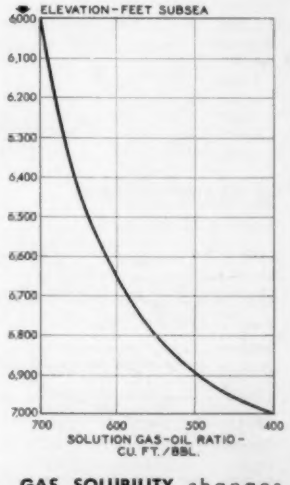
In developing a hypothetical reservoir an average change of 0.7° API per 100 ft. and an average change of 70 psi. per 100 ft. of elevation in the initial saturation pressure was used to agree in general with known data on high relief pools. The variation in the tank-oil gravity and initial saturation pressure with elevation should not be taken as linear. An oil field with a closure of 1,000 ft. between the elevations of 6,000 and 7,000 ft. is assumed. A circular homogeneous reservoir with a 5-mile radius containing a constant net sand thickness of 200 ft., a porosity of 28%, and water saturation of 10% of the pore volume is assumed. Other values



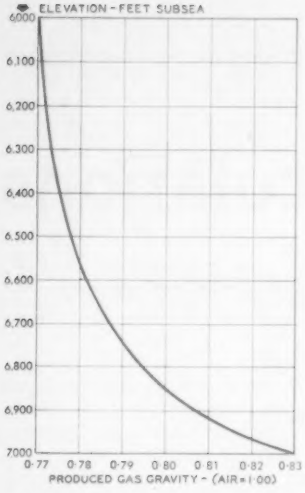
TANK-OIL GRAVITY varies 7° over 1,000-ft. change in subsea elevation. Fig. 1.



RESERVOIR TEMPERATURE varies between 140 and 160° F. over 1,000 ft. change in elevation. Fig. 2.



GAS SOLUBILITY changes from 700 to 400 cu. ft. per bbl. over 1,000 ft. change in elevation. Fig. 3.



GAS GRAVITY changes from 0.77 to 0.83 as elevation varies 1,000 ft. Fig. 4.

for the porosity and water saturation could have been used without affecting the conclusions.

The change in the tank-oil gravity is assumed to vary between 28° and 35° API (Fig. 1); the reservoir temperature to vary between 140° and 160° F. (Fig. 2). The initial solution ratio was assumed to range from 400 to 700 cu. ft. per barrel of tank oil (Fig. 3). The gravity of the produced gas was assumed to vary between 0.77 and 0.83 (Fig. 4), and the gravity of the free gas was taken as 0.7 over the reservoir conditions used in the material-balance calculations. Fig. 5 shows the original saturation pressure-elevation relationship for the assumed reservoir, obtained by applying the physical properties of the fluids in Standing's empirical PVT correlations. These relationships are normally presented in the form of three charts whereby the saturation pressure and liquid-phase formation-volume factor can be obtained by knowing such field data as the producing gas-oil ratio of a bubble-point liquid, and the produced oil and gas gravities plus the reservoir temperature. The variation in the original pressure checks the 70 psi. per 100 ft. of elevation observed in actual reservoirs. In developing the original reservoir pressure-elevation relationships also shown on Fig. 5, it was assumed that the reservoir was just saturated at the top.

The original liquid-phase formation-volume factor was obtained by applying the liquid-phase compressibility obtained from Fig. 6 showing the compressibility above the saturation pressure as a function of the saturation pressure. This curve was obtained by drawing a smooth curve through some thirty measurements of saturation pressure and liquid-phase compressibility. It is recognized that this curve is only roughly correct and also that the liquid-phase compressibility above the saturation pressure is not constant but decreases slightly with increasing pressure. However, this error can be considered negligible. Table 1 shows the calculation of the original liquid-phase volume factor. The original reservoir pressure gradient was checked by calculating the density of the liquid and gas phases. This calculation is shown on Table 2.

The relative gas density for the free gas was obtained by assuming a free gas gravity of 0.70 at reservoir conditions over the pressure range used in the material-balance calculations and determining the compressibility of the free gas from the gas gravity using the relationship that the pseudo-critical pressures and temperatures are functions of the gas gravity. This method is explained by G. G. Brown.[6] Fig. 7 shows the relative gas density as a function of pressure. Figs. 10 and 11 are the working curves for the gas solubility and liquid-phase formation-volume factor obtained from the given data using Standing's PVT correlations.

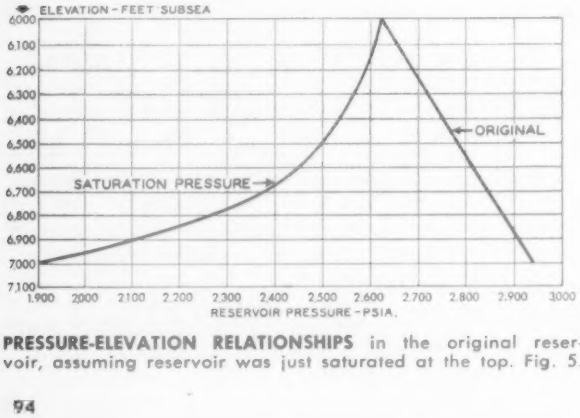
Assumptions

The past performance of the hypothetical reservoir and the material balance calculations are based on the following assumptions:

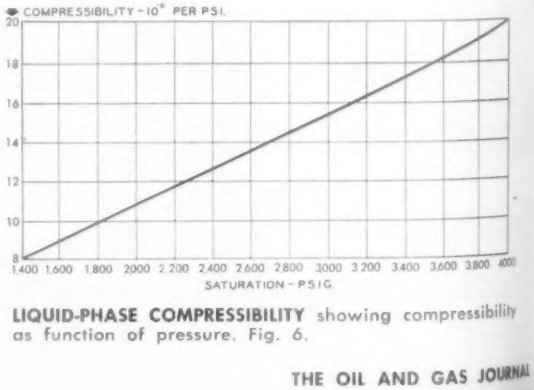
1. The reservoir consists of four layers, within each of which the properties of the fluid are the same. This

TABLE 1—CALCULATION OF ORIGINAL LIQUID PHASE FORMATION VOLUME FACTOR

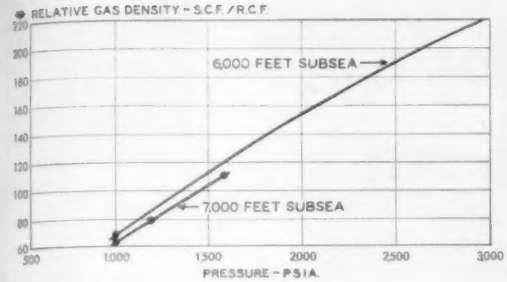
Elevation, ft. subsea	Gradient, psi./ft.	Reservoir pressure, P, psia.	Saturation pressure, P_s, psia.	ΔP	Compressibility, C, per 10^6 psi.	$C\Delta P$	Formation volume factor at P_s, B_{os}, res. bbl./ bbl. T.O.	$C\Delta PB_{os}$	Original formation volume factor, $B_{oi}=B_{os}-C\Delta PB_{os}$
6,000	0.3081	2,620	2,620		13.80		1.360		1.360
6,100	0.3095	2,651	2,605	46	13.73	0.00063	1.354	0.0009	1.353
6,200	0.3105	2,682	2,590	92	13.65	0.00126	1.350	0.0017	1.348
6,300	0.3120	2,713	2,565	148	13.53	0.00200	1.343	0.0027	1.340
6,400	0.3140	2,744	2,535	209	13.39	0.00280	1.335	0.0037	1.331
6,500	0.3160	2,776	2,500	276	13.22	0.00365	1.327	0.0048	1.322
6,600	0.3181	2,808	2,455	353	13.00	0.00459	1.318	0.0060	1.312
6,700	0.3213	2,840	2,385	455	12.66	0.00576	1.305	0.0075	1.298
6,800	0.3256	2,872	2,275	597	12.15	0.00725	1.288	0.0093	1.279
6,900	0.3323	2,905	2,110	795	11.32	0.00900	1.262	0.0114	1.251
7,000	0.3412	2,939	1,900	1,039	10.30	0.01070	1.230	0.0132	1.217



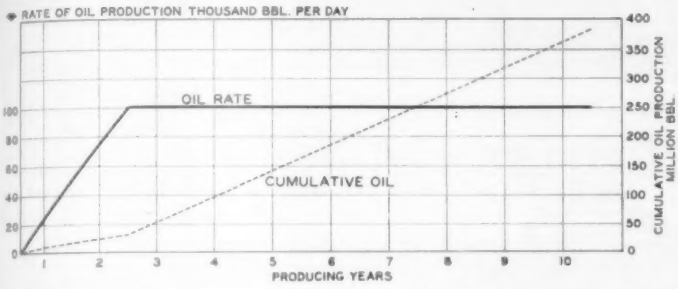
PRESSURE-ELEVATION RELATIONSHIPS in the original reservoir, assuming reservoir was just saturated at the top. Fig. 5.



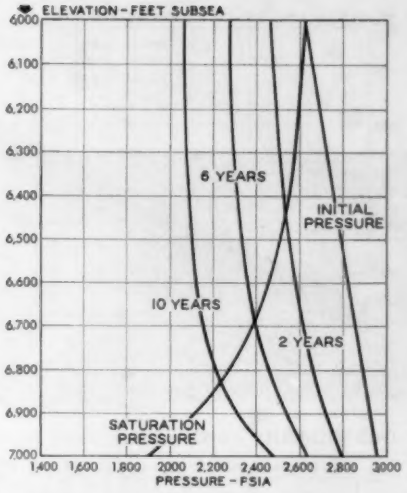
LIQUID-PHASE COMPRESSIBILITY showing compressibility as function of pressure. Fig. 6.



RELATIVE GAS DENSITY as a function of pressure. Fig. 7.



POOL-PERFORMANCE CURVE, assumed over 10½ producing years. Fig. 8.



AVERAGE PRESSURE-DEPTH RELATIONSHIPS at production periods of two, six, and ten years. Fig. 9.

applies only to the first material-balance case. The layers and mean depths used are:

6,000-6,400 ft. subsea with mean depth 6,300 ft. subsea.
6,400-6,600 ft. subsea with mean depth 6,500 ft. subsea.
6,600-6,800 ft. subsea with mean depth 6,700 ft. subsea.
6,800-7,000 ft. subsea with mean depth 6,900 ft. subsea.

2. Little or no gravity drainage.
3. Constant free gas gravity over the range of pressures considered.
4. Tank-oil and produced-gas gravities do not change with time at a given elevation.
5. Reservoir initially saturated at the crest.
6. All oil is produced between the elevations of 6,400 and 6,800 ft. subsea. Although this assumption is valid for material-balance case No. 1, slight changes in the location of the average PVT in the upper and lower zones would occur, due to drainage into the middle zones. However, for this particular case this can be ignored due to the relatively low rates of oil withdrawal.
7. Expansion of interstitial water is negligible.
8. No form of pressure maintenance.
9. No effect from rock compressibility.
10. No water drive.

Material Balance by Layers

A standard form of the material balance may be written as follows:[7]

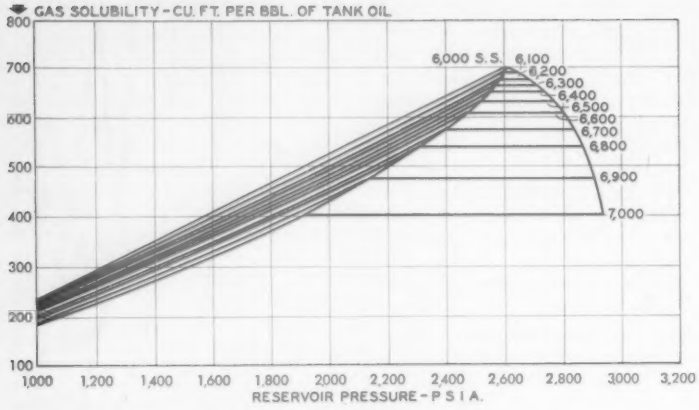
$$N = \frac{N_c(\gamma B_o - R) + G_c}{(R_i - R) - \gamma(B_{oi} - B_o)}$$

where N = oil originally in place in bbl.
N_c = cumulative oil produced in bbl. = ΣNcn;
γ = relative gas density × 5.615 cu. ft./bbl. in std. cu. ft. per reservoir barrel;
B_o = liquid phase formation volume factor in reservoir barrels per bbl. of tank oil;
G_c = cumulative gas production in cu. ft.;
B_{oi} = initial liquid phase volume factor;
R = solution gas-oil ratio in cu. ft./bbl. of tank oil;
R_i = initial solution gas-oil ratio.

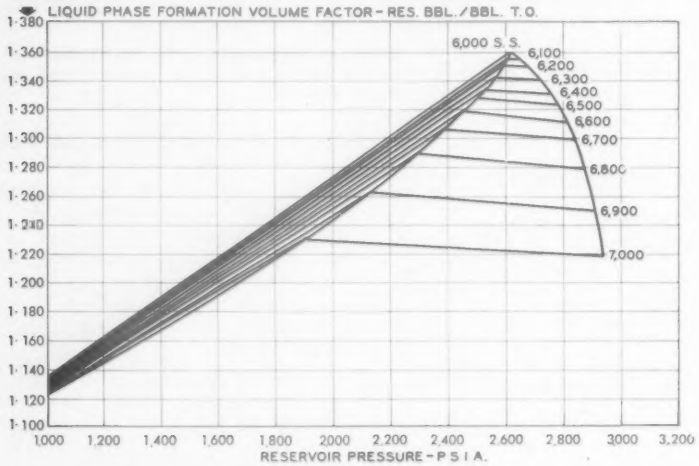
When more than one layer is used in a reservoir to consider the variation in the fluid properties the material-balance equation can be written:

TABLE 2—CALCULATION OF ORIGINAL RESERVOIR PRESSURE GRADIENT

Elevation, ft. subsea	1 Oil specific gravity, ρ_o	2 Gas gravity air=1.00, ρ_g	3 Initial solution ratio, R_s, cu. ft./bbl.	4 Wt. of tank oil per bbl., 350.16 × ρ_o, lb.	5 Wt. of produced gas per cu. ft., 0.076362 × ρ_g, lb.	6 Wt. of gas per bbl. of tank oil, 0.076362 × $\rho_o \times R_s$, lb.	7 Wt. of oil plus gas per bbl. T.O., 4+6, lb.	8 Original liquid phase formation volume factor, B_{oi}, bbl./bbl.	9 Initial reservoir pressure gradient, $\frac{7 \times 0.4331}{B_{oi} \times 350.16}$ psi./ft.
6,000	0.8498	0.770	700	297.57	0.0588	41.14	338.73	1.360	0.3081
6,100	0.8509	0.771	690	297.95	0.0589	40.64	338.59	1.353	0.3095
6,200	0.8519	0.772	680	298.30	0.0589	40.05	338.35	1.348	0.3105
6,300	0.8534	0.773	665	298.83	0.0590	39.24	338.07	1.340	0.3120
6,400	0.8550	0.775	650	299.39	0.0592	38.48	337.87	1.331	0.3140
6,500	0.8576	0.778	630	300.30	0.0594	37.42	337.72	1.322	0.3160
6,600	0.8602	0.782	607	301.21	0.0597	36.24	337.45	1.312	0.3181
6,700	0.8639	0.787	576	302.50	0.0601	34.62	337.12	1.298	0.3213
6,800	0.8686	0.795	535	304.15	0.0607	32.47	336.62	1.279	0.3256
6,900	0.8762	0.808	475	306.81	0.0617	29.31	336.12	1.251	0.3323
7,000	0.8871	0.830	400	310.63	0.0634	25.36	335.99	1.218	0.3412



GAS-SOLUBILITY working curve, using Standing's PVT correlations. Fig. 10.



LIQUID-PHASE FORMATION-VOLUME FACTOR obtained using Standing's PVT correlations. Fig. 11.

$$N = \frac{\Sigma[N_{cn}(\gamma B_o - R)] + G_c}{\Sigma\{f_n[(R_i - R) - \gamma(B_{oi} - B_o)]\}}$$

where f denotes the ratio of the tank oil originally in place in each layer to the total tank oil originally in place in the reservoir. This equation requires the introduction of the relative value of the tank oil in place from the volumetric estimate and a knowledge of oil production from each layer.

In showing the comparison of the results obtained between PVT data that varies with elevation, a volumetric average PVT and one based on the average produced oil, it is assumed that the tank oil originally in place was 12.3×10^9 bbl. to agree with the volumetric estimate. It should be emphasized, however, that other values for the tank oil originally in place could be used without affecting the conclusions. In other words, the volumetric estimate was made only for the purpose of obtaining the f factor used in the material balance equation.

Fig. 8 shows the assumed pool performance curve and Fig. 9 the assumed average pressure-depth relationship at production periods of 2, 6, and 10 years. The average rate of production is assumed at about 100,000 bbl. per day. The pressure-depth curves used were arbitrarily made to give values of tank oil in place of 12.3×10^9 bbl., using the material-balance case where the PVT data vary with elevation. The other material balances are calculated to show how inconsistent their results are and how greatly their answers vary from the assumed realistic answer.

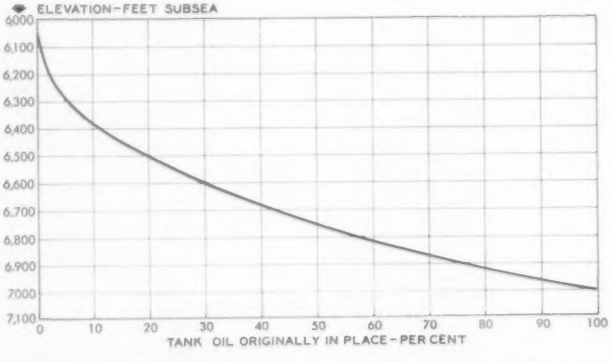
Table 3 shows a material-balance calculation based upon a producing period of 10 years, using the method of dividing the reservoir into four separate layers. From the calculations it is clearly evident the most critical factor in the material balance is the saturation pressure-elevation relationship which determines the value of $f(R_i - R)$. Because of the critical nature of this factor, the reservoir is separated into small layers, each 100 ft. in thickness, in the region where the pressures have fallen below the initial saturation pressures.

Material Balance Using Weighted Average PVT

The weighted average PVT was based upon the mean gravity of the tank oil originally in place. The mean elevation of this average oil is taken from Fig. 12 at about 6,750 ft. subsea. A material balance after 10 years of production using the PVT at this elevation is shown in Table 4. In analyzing the calculations it is clearly evident that this type of PVT does not consider the average effect of the reservoir pressure on the solution ratio but only the effect at one elevation. Although this material balance gave a value of tank oil in place of 14.8×10^9 bbl. with an error of only 16.9%, the material balance after 6 years of production using this PVT resulted in a tank oil in place of 52.1×10^9 bbl. with an error of over 300%.

Material Balance Using a PVT at an Elevation of 6,600 ft. Subsea

A material balance based upon the average elevation of produced oil after the 10-year production period is shown in Table 4. The calculated tank oil in place in this case was only



TANK OIL ORIGINALLY IN PLACE, as function of subsea elevation. Fig. 12.

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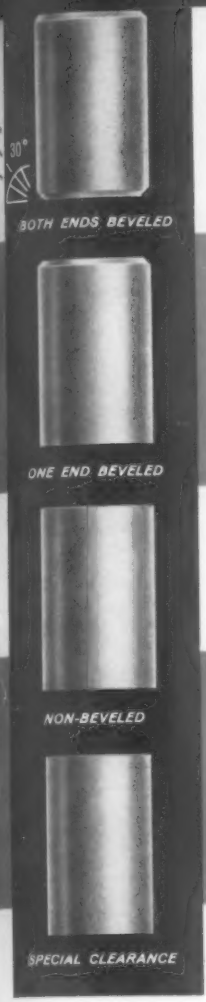

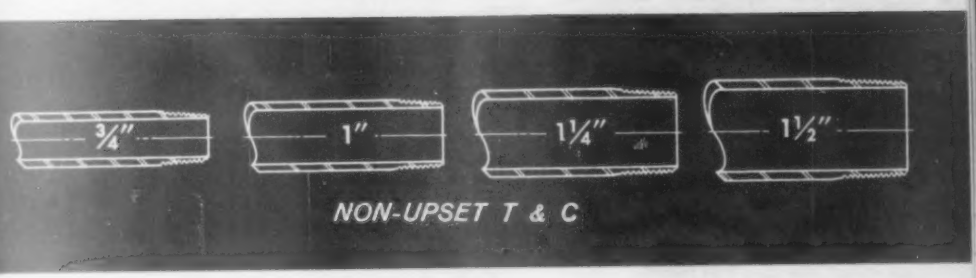

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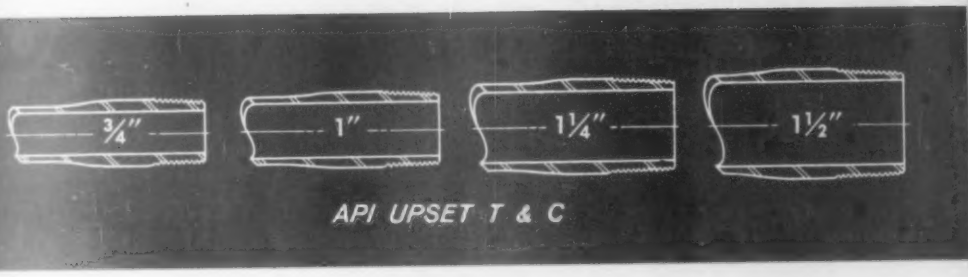

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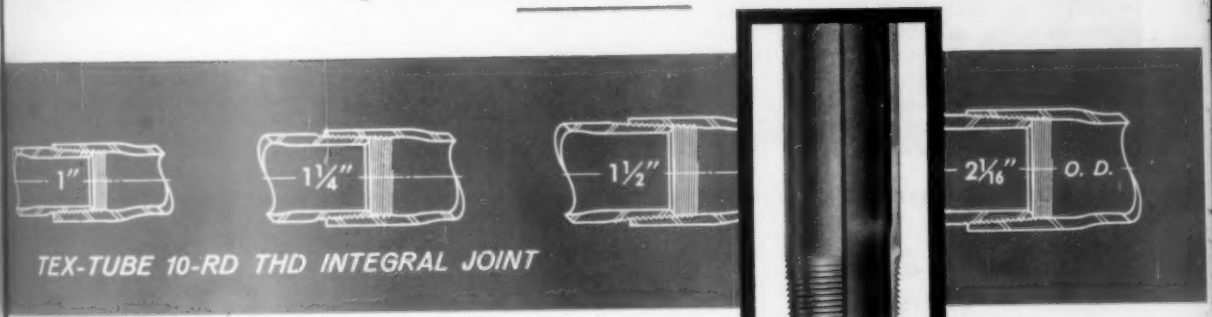

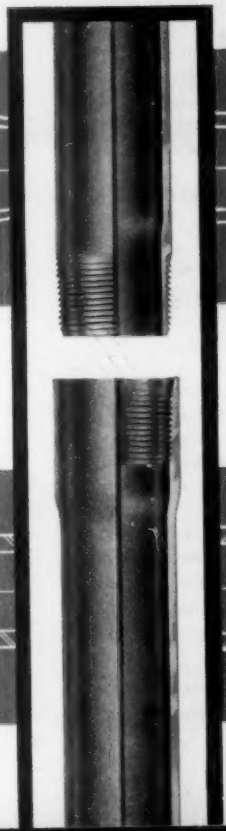

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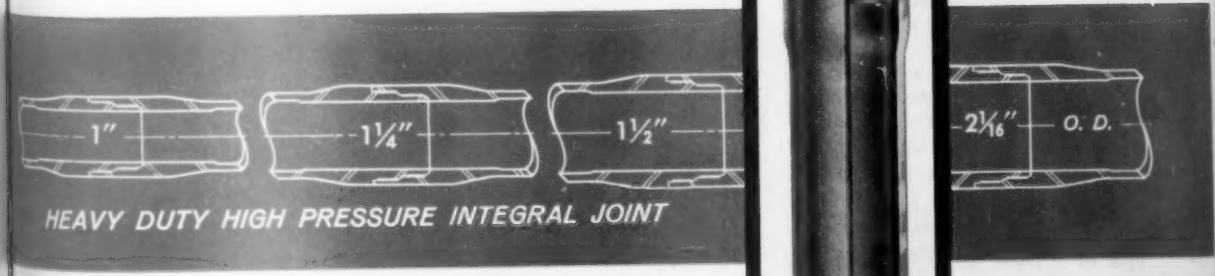

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5.7×10^9 bbl. or 54% lower than the given value of 12.3×10^9 bbl. In this case too much weight was placed on the change in the solution ratio at this elevation and time relative to the average change in the reservoir.

Conclusions

Table 5 shows a summary of the results of the three material balance methods at 2, 6, and 10-year periods and how they differ from the given value of the tank oil in place.

Separating the reservoir into layers for the purpose of a material balance becomes even more important when an initial gas cap is present.

Partial water drive could have been assumed for the hypothetical reservoir, but the comparative results would have been quite similar to those obtained. In a given highly undersaturated reservoir it becomes evident that the results of a material balance are dependent entirely on the compressibility of the liquid phase, and therefore the proper PVT would be one based upon the produced oil as long as the reservoir is everywhere above the saturation pressure.

The following are the important conclusions that can be derived from this paper:

1. The most realistic method of determining the value of the tank oil in place by the material balance in an oil reservoir that is saturated at or near the crest is one that considers the variation in the fluid properties with elevation. This is clearly evident from the inconsistency of the other two material-balance results.

2. Where the fluid properties vary with elevation in a reservoir saturated at or near the crest, the saturation pressure-elevation relationship is the most critical factor in estimating the reserves by the material balance method.

TABLE 4—MATERIAL BALANCE ON A GIVEN HYPOTHETICAL RESERVOIR AFTER A PRODUCING PERIOD OF 10 YEARS

A = using a weighted average PVT
B = using an average tank-oil PVT

$$N = \frac{N_c(\gamma B_o - R) + G_c}{(R_i - R) - \gamma(B_{oi} - B_o)}$$

	Symbol	Unit	A 6,750 ft. PVT	B 6,600 ft. PVT
Cumulative production:				
Oil	N_c	Bbl. $\times 10^6$	380	380
Gas	G_c	M.c.f. $\times 10^6$	258	258
Pressure	P	Psia.	2,200	2,132
Relative gas density	γ	S.c.f./R.C.F.	165	161
Liquid phase f.v.p.	B_o	Res. bbl./bbl. T.O.	1.279	1.274
γB_o			211.035	205.110
$5.615\gamma B_o$			1,185	1,152
Solution gas-oil ratio	R	S.c.f./bbl. T.O.	512	507
$5.615\gamma B_o - R$		S.c.f./bbl. T.O.	673	645
$N_c(5.615\gamma B_o - R)/1{,}000$		M.c.f. $\times 10^6$	256	245
$N_c(5.615\gamma B_o - R)/1{,}000 + G_c$		M.c.f. $\times 10^6$	514	504
Initial liquid phase f.v.f.	B_{oi}	Res. bbl./bbl. T.O.	1.288	1.312
$(B_{oi} - B_o)$		Res. bbl./bbl. T.O.	+0.009	+0.038
$\gamma(B_{oi} - B_o)$			+1.485	+6.118
$-5.615\gamma(B_{oi} - B_o)$		S.c.f./bbl. T.O.	−8.337	−34.353
$(R_i - R)$			43	123
Tank oil in place	T.O.I.P.	Bbl. $\times 10^9$	14.83	5.68

TABLE 5—SUMMARY OF MATERIAL BALANCE RESULTS

	Method: Changing PVT	Weighted average PVT	Average tank oil PVT
Assumed tank oil originally in place, billion bbl.	12.3	12.3	12.3
Calculated tank oil in place (2 years' production)	12.3	16.6	18.4
Error, %		+35.0	+49.6
Calculated tank oil in place (6 years' production)	12.3	52.1	6.6
Error, %		+323.6	−46.3
Calculated tank oil in place (10 years' production)	12.3	14.8	5.7
Error, %		+16.9	−53.7

TABLE 3—MATERIAL BALANCE ON A GIVEN HYPOTHETICAL RESERVOIR AFTER A PRODUCING PERIOD OF TEN YEARS USING A CHANGING PVT

$$N = \frac{\Sigma[N_c(\gamma B_o - R)] + G_c}{\Sigma\{f[(R_i - R) - \gamma(B_{oi} - B_o)]\}}$$

	Symbol	Unit	Top to 6,400 ft. s.s., 6,300 ft. PVT, f = 0.1098	6,400-6,600 ft. s.s., 6,500 ft. PVT, f = 0.1915	6,600-6,800 ft. s.s., 6,700 ft. PVT, f = 0.2917	6,800-7,000 ft. s.s., 6,900 ft. PVT, f = 0.4070	Total
Cumulative production:							
Oil	N_c	Bbl. $\times 10^9$		190	190		
Gas	G_c	M.c.f. $\times 10^6$		129	129		
Pressure	P	Psia.	2,078	2,105	2,172	2,322	
Relative gas density	γ	S.c.f./R.C.F.	157	158	163	166	
Liquid phase f.v.f.	B_o	Res. bbl./bbl. T.O	1.275	1.272	1.276	1.258	
γB_o				201	208		
$5.615\gamma B_o$				1,129	1,168		
Solution gas-oil ratio	R	S.c.f. bbl. T.O.		510	507		
$5.615\gamma B_o - R$		S.c.f. bbl. T.O.		619	661		
$N_c(5.615\gamma B_o - R)/1{,}000$		M.c.f. $\times 10^6$		118	126		
$N_c(5.615\gamma B_o - R)/1{,}000 + G_o$		M.c.f. $\times 10^6$		247	225		502
Initial liquid phase f.v.f.	B_{oi}	Res. bbl./bbl. T.O	1.340	1.322	1.298	1.251	
$(B_{oi} - B_o)$		Res. bbl./bbl. T.O	+ 0.065	+ 0.050	+ 0.022	−0.007	
$\gamma(B_{oi} - B_o)$			+10.205	+ 7.900	+ 3.586	−1.162	
$5.615\gamma(B_{oi} - B_o)$		S.c.f./bbl. T.O.	+57.301	+44.359	+20.135	−6.525	
$-f[5.615\gamma(B_{oi} - B_o)]$		S.c.f./bbl. T.O.	− 6.292	− 8.495	− 5.873	+2.656	−18.004
$\Sigma f(R_i - R)$		S.c.f./bbl. T.O.	16.624	23.416	18.612		58.652
							40.648
Tank oil in place	T.O.I.P.	Bbl. $\times 10^9$					12.34

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Appendix

The following development is to show that there is very little error in the material balance results due to oil migration by assuming that all of the production is obtained from the interval between the elevations 6,400 ft. subsea and 6,800 ft. subsea.

The gas balance for the assumed production block may be written as:

$$NR_i = (N - N_c)R - N_m R_m + [NB_i - (N - N_c)B - N_m B_m]\gamma + G_c \quad (1)$$

or:

$$NR_i + N_m(R_m - \gamma B_m) = (N - N_c)R + [NB_i - (N - N_c)B]\gamma + G_c \quad (2)$$

where:

N = oil originally in place
R_i = original solution gas-oil ratio
N_c = cumulative tank oil
R = solution gas-oil ratio
N_m = migrated oil
R_m = solution gas-oil ratio for migrated oil
B_i = initial liquid phase formation volume factor
B = formation volume factor
B_m = formation volume factor of migrated oil
γ = relative gas density for the free gas in the reservoir
G_c = cumulative gas produced

The maximum error in assuming that the migrated oil term

$$N_m(R_m - \gamma B_m)$$

is equal to $N_m(R - \gamma B)$ can be obtained by comparing the maximum and minimum probable values for N_m, R_m, and B_m.

It can be assumed that in calculating the oil reserves by the material balance the maximum probable oil that will be drained into the producing block would not exceed 25% of the tank oil originally in place in the reservoir when the cumulative produced tank oil is about 50% of the oil originally in place.

Further the maximum probable difference between $N_m(R_m - \gamma B_m)$ and $N_m(R - \gamma B)$ for the reservoir conditions used in the report is obtained by assuming that the migrated oil is all from below. This condition, however, can never be attained because there will always be some oil migration into the producing zone from above. The maximum possible value for $(R_m - \gamma B_m) - (R - \gamma B)$ will not exceed 22% of R_i.

Therefore the maximum error introduced by neglecting the second term on the left side of Equation 2 is $0.25 \times 22 = 5.5\%$. This is also the error in the calculated value of N, the tank oil in place.

In general the material balance will only be applied when the cumulative production N_c is very much less than 50% of N and N_m is proportionally small. Moreover, part of the drainage will be up and part down so that the difference in the values of $\gamma B - R$ will be less. Hence the error introduced by neglecting the term for the migrated oil will be far less than 5.5%.

Note: This article has also been published in the Journal of the Institute of Petroleum, 61 Cavendist Street, London W1.

Tank gaging now automatic at Port Moody

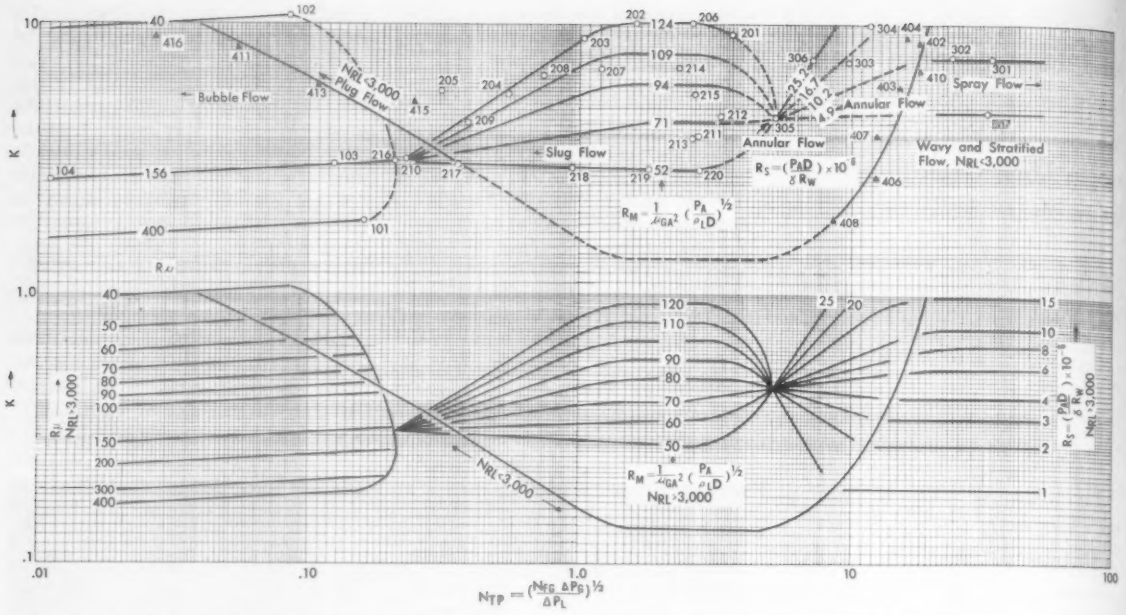
GAGER Clay Boiteau gages a tank in 15 seconds at the Port Moody refinery of British American Oil Co. All tanks can be done in 20 minutes. The new Varec system used to do the job is accurate to ⅛ in. and provides yield and product transfer data much more efficiently than previously possible.

The gaging operation is conducted merely by turning a dial in the centrally located control room. Floats in each tank measure the level, and transmitters convey the information in the form of dots and dashes to a pulse receiver in the control room. These are translated into liquid-level figures which are flashed on an illuminated viewing screen.

After 6 seconds—long enough to record the level—the image fades and is replaced by the average temperature for the tank, also necessary for accurate measure of the volume of product.

Tank temperatures are measured accurately by means of a series of resistance-type temperature bulbs suspended in each tank. As the temperature of the wire changes, its electrical resistance changes proportionately and is then converted electrically into a temperature reading. This is transmitted as a pulse code to the control-room receiver where it is translated into a temperature figure and flashed on the screen.

The individual level and temperature sections of the system are put in motion by dialing the number of a particular tank.



TWO-PHASE FLOW CORRELATIONS show effects of various variables on flow patterns. Upper chart, Fig. 1, shows experimental data. Lower chart, Fig. 2 is a generalized correlation based on Fig. 1.

Charts help determine pressure drops in horizontal pipes carrying liquid and gas. Dimensionless parameters are used in this . . .

New correlation for 2-phase pipeline flow

BY DR. JOSE A. CHAVEZ

. . . who has been working with Creole Petroleum Corp. since 1951 on the design of gasoline plants, gas-gathering systems, and transmission lines. He received his BS degree in mechanical engineering from Purdue University and his doctorate from Universidad Central de Venezuela.

TWO-PHASE FLOW of liquid and gas occurs in many industrial plants where heating and cooling of the fluids being processed are required. For example, two-phase mixtures of petroleum fractions flow through heat exchangers and fired heaters; partially condensed water vapor flows through steam lines and condensers. Two-phase flow of crude oil and gas occurs in gathering lines of producing oil wells. In recent years there has been an increasing tendency to transport both oil and gas simultaneously through long pipelines in an attempt to reduce pipeline investment and transportation costs.

For all these cases the designer needs to estimate pressure drops with a certain degree of accuracy. Several correlations have been published to solve this problem; however, none of these correlations have proved their reliability when applied to flowing conditions different from those for which they were developed.

This correlation relates the different variables which have apparent effect upon the two-phase flow of fluids in pipelines. The work of preparing this correlation was undertaken as a step towards grouping the wide range of data which have been available to the author and presenting them in a generalized form for easy application in computing pressure drops under conditions of two-phase flow. By relating the many different variables this correlation presents a new concept in the treatment of two-phase flow problems.

This correlation is presented on Fig. 2 which is an extrapolation of Fig. 1. The average deviation of this correlation was calculated to be +6% and −5%. Table 2 shows a comparison between the measured and the calculated pressure drops. However, more data will be required to completely establish the validity of this correlation.

Experimental data used . . . The correlation of Fig. 1 is based on the data contained in References 1 through 4, and some data by the author; the range of these data is shown on Table 1. The method of Reference 5 was used to calculate the elevation effect on the pressure drop from pipelines on uneven terrain and to correct the data accordingly.

Derivation of Two-Phase-Flow Equation

When a liquid and a gas are flowing simultaneously in a pipe, the two-phase pressure drop can be expressed as a function of the liquid pressure drop as,

$$\Delta P_{TP} = (f_{TPL}/f_L)\,(A/A_L)^{5/2}\,\Delta P_L, \quad (1)$$

or as a function of the gas pressure drop as,

$$\Delta P_{TP} = (f_{TPG}/f_G)\,(A/A_G)^{5/2}\,\Delta P_G, \quad (2)$$

TABLE 1
RANGE OF DATA USED

Volumes			
Liquid, B/D	70	—	56,000
Gas, M.s.c.f.d	20	—	27,000
Gravities			
Liquid, °API	14	—	104
Gas, sp. gr. (Air=1.00)	0.59	—	0.80
Viscosities			
Liquid, cp.	0.40	—	1,500
Gas, cp.	0.010	—	0.015
Average line pressure, psig.	30	—	1,100
Line diameter, in.	3	—	12
Fluids			
Liquids	Petroleum oils and condensate		
Gas	Natural gas		
Length of line, ft.	600	—	135,000
Two-phase pressure drop, psi.	0.5	—	230

since the pressure drop for one phase flowing alone in the pipe is directly proportional to the friction factor and inversely proportional to the fifth power of the pipe diameter (or five-halves power of the pipe cross-sectional area).

As the area occupied by the liquid, A_L, plus the area occupied by the gas, A_G, must equal the pipe cross-sectional area during two-phase flow, then

$$A_L/A + A_G/A = 1 \qquad (3)$$

Substituting the values of A_L/A and A_G/A from Equations 1 and 2 respectively into Equation 3, this becomes

$$[(f_{TPL}/f_L)(\Delta P_L/\Delta P_{TP})]^{2/5} + [(f_{TPG}/f_G)(\Delta P_G/\Delta P_{TP})]^{2/5} = 1$$

or

$$[(f_{TPL}/f_L)\Delta P_L]^{2/5} + [(f_{TPG}/f_G)\Delta P_G]^{2/5} = \Delta P_{TP}^{2/5} \qquad (4)$$

As the friction factors f_{TPL} and f_{TPG} are difficult to evaluate simultaneously, a new factor K, which will be called the deviation factor, is used in substitution of the above friction factors, such that

$$K = \left(\frac{\Delta P_L^{2/5} + \Delta P_G^{2/5}}{[(f_{TPL}/f_L)\Delta P_L]^{2/5} + [(f_{TPG}/f_G)\Delta P_G]^{2/5}} \right)^{5/2} \qquad (5)$$

or

$$K = \frac{[1 + (\Delta P_G/\Delta P_L)^{2/5}]^{5/2}}{(\Delta P_{TP}/\Delta P_L)} = \frac{[1 + (\Delta P_L/\Delta P_G)^{2/5}]^{5/2}}{(\Delta P_{TP}/\Delta P_G)} \qquad (6)$$

The area occupied by the gas phase during two-phase flow will then be computed as follows:

Equating Equations 1 and 2, the ratio of the areas occupied by the flowing phases becomes

$$A_L/A_G = [(f_{TPL}/f_L)(f_G/f_{TPG})(\Delta P_L/\Delta P_G)]^{2/5} \qquad (7)$$

Substituting the value of f_{TPL}/f_L from Equation 7 into Equation 5, then

$$K = (f_G/f_{TPG}) \times \left(\frac{(\Delta P_L/\Delta P_G)^{2/5} + 1}{(A_L/A_G) + 1} \right)^{5/2} \qquad (8)$$

Assuming that the gas friction factors can be expressed by Weymonth's equation as $f = \text{constant}/D^{1/3}$, then

$$f_G/f_{TPG} = (D_G/D)^{1/3} = (A_G/A)^{1/6} \qquad (9)$$

substituting into Equation 8, this becomes

$$K = (A_G/A)^{5/3}[(\Delta P_L/\Delta P_G)^{2/5} + 1]^{5/2}$$

Solving for A_G/A, the fraction of pipe area occupied by the gas phase can be expressed as

$$A_G/A = \frac{K^{3/8}}{[(\Delta P_L/\Delta P_G)^{2/5} + 1]^{15/16}} = (\Delta P_G/\Delta P_{TP})^{3/8} \qquad (10)$$

Equation 6 will be used in estimating two-phase pressure drops and Equation 10 in estimating the fraction of pipe area occupied by the gas phase.

Correlating Parameters and Transition Zones

The solution of Equation 6 requires that the deviation factor K be known. Based on the data available at hand, K was plotted against the dimensionless number N_{TP} as shown on Fig. 1. This number is defined as

$$N_{TP} = N_{FG}^{1/2}(\Delta P_G/\Delta P_L)^{1/2} \qquad (11)$$

$$N_{FG} = V_G/(Dg)^{1/2} = Q_G/A(Dg)^{1/2} \qquad (12)$$

The data plotted show two zones of convergence: one at N_{TP} of about 0.21 and the other at N_{TP} of about 5.2. These zones of convergence seem to be transition zones establishing some flow criteria yet unknown. More data are required to perfectly determine these zones of convergence.

As shown on Fig. 1, three dimensionless parameters were found to group the data between the zones of convergence. These are as follows:

R_μ = ratio of liquid to gas absolute viscosities for values of N_{TP} up to 0.21 (13)

$R_M = (P_A/\rho_L D)^{1/2}(1/P_{GA}^2)$ for values of N_{TP} between 0.21 and 5.2 (14)

TABLE 2 — COMPARISON OF MEASURED VS. CALCULATED TWO-PHASE FLOW PRESSURE DROPS

Data point No.	ΔP_{TP} Measured	ΔP_{TP} Calculated	% Deviation
101	105.0	105.0	0.0
102	87.5	87.5	0.0
103	100.0	100.0	0.0
104	54.0	54.0	0.0
201	32.0	32.0	0.0
202	10.0	10.0	0.0
203	17.0	17.0	0.0
204	6.0	5.9	— 1.7
205	10.0	14.5	+45.0
206	29.0	29.0	0.0
207	14.0	11.1	—20.7
208	24.0	27.0	+12.5
209	16.0	16.4	+ 2.5
210	18.0	18.0	0.0
211	102.0	90.1	—11.7
212	157.0	164.4	+ 4.7
213	132.0	113.6	—13.9
214	95.0	80.8	—14.9
215	225.0	209.7	— 6.8
216	100.0	100.0	0.0
217	100.0	100.0	0.0
218	100.0	100.0	0.0
219	100.0	100.0	0.0
220	100.0	100.0	0.0
301	19.0	19.0	0.0
302	19.0	19.0	0.0
303	20.0	18.5	— 7.5
304	21.0	22.6	+ 7.6
305	15.0	15.0	0.0
306	16.0	16.0	0.0
307	9.0	9.0	0.0
*401	0.5	....	....
402	1.5	1.6	+ 6.7
403	1.5	1.9	+26.7
404	1.0	1.5	+50.0
*405	2.0	....	....
406	7.0	6.1	—12.9
407	7.5	9.2	+22.7
408	10.0	10.0	0.0
409	2.5	1.8	—28.0
410	4.0	3.5	—12.5
411	30.0	28.6	— 4.7
*412	12.0	....	....
413	13.5	13.3	— 1.5
*414	10.5	....	....
415	17.0	13.8	—18.8
416	9.0	7.2	—20.0
*417	9.0	....	....

*These points are not shown on Fig. 1 since their K values are bigger than 1.00.

$$R_S = P_A D/\gamma R_W \text{ for values of } N_{TP} \text{ higher than } 5.2 \quad (15)$$

It can be noticed from Equations 14 and 15 that the deviation factor is affected by the line pressure and diameter.

Flow Patterns

Tentatively, the different flow patterns that have been observed in two-phase flow are shown on Fig. 1. Description of these flow patterns can be found in References 1 and 2.

A convergence zone is shown on Fig. 1 in the range of N_{TP} corresponding to annular flow. This seems to indicate that there is a flow pattern other than annular flow taking place before or after the convergence zone. Wavy, stratified and plug flows appear to be special types of flow taking place when the liquid Reynolds number is below 3,000.

Illustrative Example

The following example will illustrate the use of Fig. 2:

A 12.00-in. i.d. line 42,300 ft. long with an inlet pressure of 364 psia. was passing 56,000 bbl. per day of 62.9° API gravity oil at pipeline conditions and 4,287 M.s.c.f.d. of 0.77 gravity gas. The line temperature was 100° F. The viscosity of the oil was 0.42 cp. and that of the gas 0.0105 cp. Determine the two-phase pressure drop in this line.

Solution:

Step 1—Calculate ΔP_L and ΔP_G. From known methods ΔP_L is calculated to be 62.8 psig. and ΔP_G 0.89 psig. at an assumed average line pressure of 300 psia.

Step 2—Calculate the two-phase flow number N_{TP}

$$N_{TP} = \left(\frac{N_{FG}\,\Delta P_G}{\Delta P_L} \right)^{1/2}$$

$$N_{FG} = \frac{Q_G}{A\,(Dg)^{1/2}}$$

$$= \frac{\frac{4{,}287{,}000}{86{,}400} \times \frac{14.7}{300} \times 0.95 \frac{(460+100)}{(460+60)}}{(\pi/4)\,(12/12)^2 \left(\frac{12 \times 32.2}{12} \right)^{1/2}}$$

$$= 0.56$$

$$\Delta P_G / \Delta P_L = 0.89/62.8 = 0.0142$$

$$N_{TP} = (0.56 \times 0.0142)^{1/2} = 0.09$$

Step 3—Calculate parameter $R\mu$ since N_{TP} is below 0.21 and N_{RL} is larger than 3,000.

$$R\mu = 0.42/0.0105 = 40$$

From Fig. 2 the deviation factor K = 1.05.

Step 4—Calculate ΔP_{TP} from Equation 6

$$\Delta P_{TP}/\Delta P_L = \frac{[1+(0.89/62.8)^{2/5}]^{5/2}}{1.05}$$

$$= 1.45$$

$$\Delta P_{TP} = 62.8 \times 1.45 = 91 \text{ psig.}$$

Step 5—Check the line average pressure assumed in Step 1.

$$P_A = 364 - 91/2 = 318.5 \text{ psia.}$$

As the assumed average line pressure in Step 1 was 300 psia., a new trial is required.

$$N_{TP} = 0.09\ (300/318.5) = 0.084$$

$$\Delta P_G = 0.89\ (300/318.5) = 0.838$$

From Fig. 1, for $R\mu = 40$, K = 1.08.

$$\Delta P_{TP}/\Delta P_L = \frac{[1+(0.838/62.8)^{2/5}]^{5/2}}{1.08}$$

$$= 1.39$$

Therefore, $\Delta P_{TP} = 62.8 \times 1.39 = 87.5$ psig. This example is included in the correlation of Fig. 1. The fraction of pipe occupied by the gas phase can then be computed from Equation 10 as follows:

$$A_G/A = (\Delta P_G/\Delta P_{TP})^{3/8}$$

$$= (0.838/97.5)^{3/8}$$

$$= 0.168 \text{ (or } 16.8\%)$$

Summary

1. Data available was plotted and shown on Fig. 1. These data were taken in pipelines ranging from 3 to 12 in. in diameter and under pressures varying from 30 to 1,100 psig.

2. New parameters were found to group the data. Based on these parameters a generalized correlation is proposed for estimating pressure drops. The average deviation of this correlation from the data plotted is + 6% and − 5%.

3. Two convergence zones (smooth transition zones) were found from the data; these zones appear to establish some flow criteria yet unknown. The different flow patterns observed in two-phase flow are shown in the correlation.

4. More data corresponding to the zones of convergence and for liquid Reynolds number below 3,000 are required before a definite correlation can be established.

Nomenclature

A_G = area occupied by gas phase, ft.²
A_L = area occupied by liquid phase, ft.²
A = cross-sectional area of pipe, ft.²
D = i.d., ft.
f_G = friction factor of gas phase if flowing alone in pipe
f_L = friction factor of liquid phase if flowing alone in pipe
f_{TPG} = two-phase friction factor due to the gas during two-phase flow
f_{TPL} = two-phase friction factor due to the liquid during two-phase flow
g = acceleration of gravity, 32.2 ft./sec.²
K = deviation factor
L = line length, ft.
N_{FG} = Froude's number of gas phase at pipeline conditions, dimensionless
N_{TP} = two-phase flow number, dimensionless
P_A = average line pressure in two-phase flow, lb./ft.² absolute
Q_G = volume of gas at flowing conditions, ft.³/sec.
R_{NL} = Reynold's number of the liquid phase
R_W = ratio of gas to liquid weight flow rates
V_G = velocity of gas at flowing conditions, ft./sec.
ρ_L = specific weight of liquid, lb./ft.³
ΔP_L = pressure drop of liquid phase if flowing alone in the pipe, psig.
ΔP_G = pressure drop of gas phase if flowing alone in the pipe, psig.
ΔP_{TP} = two-phase pressure drop, psig.
γ = liquid surface tension, lb./ft.
μ_{GA} = absolute viscosity of gas phase referred to that of air (0.019 cp. at 100° F.)

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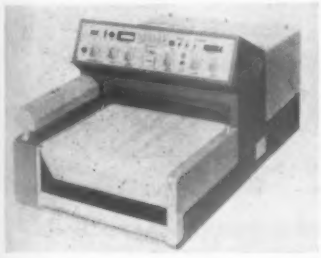
▸▸▸ New Equipment Section

This week's SHOWCASE features . . .

Engine exhaust powers cleaning gun

. . . now available for cleaning and maintaining oil-field equipment. The X-O Kleen gun is a high-pressure type operated by diesel or gas-engine exhaust and requires no electricity or pipe water.

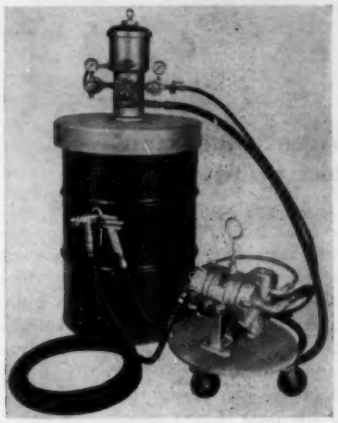
The maker says it will do everything an expensive steam cleaning plant will do, but at a fraction of the cost and right where the equipment is working. The device is portable and weighs only 15 lb. It consists of a 14-ft. or more length of flexible stainless-steel tubing fitted with a specially designed cap. The cap adapts to any size exhaust stack. The rubber suction hose is dropped into any 5-gal. water can to draw up the cleaning solution—steam-cleaning compound, diesel oil, or water. Pressure is varied by opening or closing the engine throttle. The gun sells for about $100. **Contact Manufacturer: Seaboard Sales of Washington, Inc., Bellingham, Wash., for details on X-O Kleen gun.**



Oscillograph records 50 channels

. . . of test data on a 12-in. wide record. This new Model 603 oscillograph provides direct recording and readout. Record speeds are variable from 0.05 to 170 in. a second, allowing engineers to select the best operational condition for recording a particular test event.

The machine uses light-beam type of galvanometers with accurate response up to 6,000 c.p.s. and a direct-writing process with a trace-writing capability exceeding 30,000 in. a second. Thus it is capable of recording fast-occurring and short-duration phenomena with exceptional detail and accuracy. **Contact Manufacturer: Midwestern Instruments, Inc., P. O. Box 7186, Tulsa, for details on Model 603 Oscillograph.**



Heated-coating application package

. . . now being produced for the heated application of coal-tar and asphalt-type materials is specially designed for use at high pressure. Components of the Powermastic package include a pump, heater, and materials gun. When heated coatings leave the gun, most of the solvent evaporates immediately, giving a high-solids film deposit and fast drying.

The pump has a double action and is powered by a 4¼-in. air motor. It delivers up to 5 gal. a minute at 1,000 psi. The heating unit is rated at 4 kw. and a working pressure of up to 1,500 psi. The gun for applying the mastics and other heavy materials provides regulation of both atomizing and materials pressure. **Contact Manufacturer: Spee-Flo Co., 6614 Harrisburg Boulevard, Houston, for details on Powermastic package.**

Send this **Showcase Coupon**

to the **Manufacturer** of the item in which you are interested. See name, address, and equipment name and/or model, in bold-face type at end of description.

NAME AND/OR MODEL NUMBER.....

.....

Described in OIL AND GAS **JOURNAL** · Issue of August 24, 1959

NAME.....TITLE.....

COMPANY.....

ADDRESS.....

CITY.....STATE.....

Wrench lubricates plug valves

. . . automatically each time the valve is operated. This latest development for plug valves promises to save costly plug-valve repairs by keeping them lubricated. When the handle is pulled down to open or close the valve, a pawl on the handle turns the grease cap, pushing a predetermined amount of grease into the lubricating channels of the plug. Upon release, the handle returns to its original upright position enabling the pawl to catch on the next grease-cap notch.

The Lubewrench attaches to the valve stem in the same way as other types of wrenches. The set screw enables it to fit valves in sizes from ½ through 4 in. **Contact Manufacturer: Harrisburg, Inc., Box 1053, Houston, for details on Lubewrench.**

●

Three new models of selector valve

. . . are now being produced. The three valves offer features previously not available in multiport rotary selector valves, the maker announces. Model 424-15C is rated for 1,500 psi. and has built-in flanges. Model 424-6C is designed specifically for use on four-well installations.

Model 736-6C has seven 3-in. inlet ports and a common 6-in. outlet. It is designed primarily for high-volume flow or paraffin conditions. Discharge lines in the valves have been lowered and placed on a 45° angle. Lower portion of the valve is designed to slope into the discharge line, giving a self-cleaning action to prevent build-up of materials in the valve body. All three valves are designed for easy conversion to automatic operation. **Contact Manufacturer: Win-Well Mfg. Co., Atlas Life Building, Tulsa, for details on multiport selector valves.**

●

Drilling mud sand remover

. . . just put on the market handles 400 g.p.m. at 25 psi. and 510 g.p.m. at 40 psi. Maintenance is made easy through the use of replaceable Hycar liners. The key component of the unit is a 12-in. DorrClone built with large openings to prevent plugging by lost-circulation materials.

The 12-in. DorrClone has the same basic features as the 6-in. units used in previous D-Sanders. Laboratory tests of field-test samples separated by the Model 112 indicate virtually complete removal of sand in the size range most likely to cause trouble, the maker reports.

The machine can be had with or without a pump and engine. **Contact Manufacturer: Salt Water Control, Inc., 1809 Continental National Bank Building, Fort Worth, Tex., for details on Model 112 D-Sander.**

●

Latest expansion-joint development

. . . is designed for temperatures up to 1,200° F. The joint embodies a packed slip joint that has a stainless-steel packing surface. The mounting base and adjustable centering-roller support are an integral part of the unit and remove the weight of the slip joint from the packing and gland.

Outstanding features of the joint are that no precompression is required and the joint will not take a permanent set. The unit has a 3-in. traverse with a 20-in. face-to-face maximum. The expansion joint is relatively lightweight. As an example, a 30-in. size weighs only 600 lb. **Contact Manufacturer: Ka-cy Mfg. Co., Inc., 207 Reinerman Street, Houston, for details on expansion joint.**

●

Simplified liquid-level detector

. . . just brought out uses nuclear radiation. The Model GM-7 Gamma switch is used with a source of radioactive material to provide high or low-level alarm actuation or both without contacting the material in the tank or vessel. A Geiger-Mueller tube detects gamma radiation and, through a transistorized integrating circuit, applies voltage to a thyratron relay grid. The thyratron actuates an on-off adjustable-limit latching relay to operate alarms.

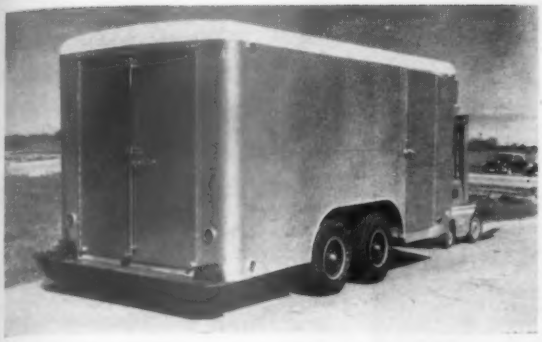
Switch components are sealed in a steel explosionproof enclosure 21 in. long. The unit weighs 30 lb. It operates on a.c. power at 115 volts and 60 c.p.s. It requires 0.5 amp. Price of the GM-7 switch is $190. A complete level-gaging system may be obtained for less than $500. **Contact Manufacturer: Ohmart Corp., 2236 Bogen Street, Cincinnati 22, for details on GM-7 switch.**

●

Truck-mounted crane eases lifting

. . . of a variety of equipment and materials. Only recently announced, the crane is also made in a dolly-mounted version. Two capacities are available—1,500 and 2,500 lb.

The truck-mounted unit can be installed on a pickup truck with the use of an inside or outside mount. It can be used with any number of trucks equipped with the mounts. It is also interchangeable with the dolly-mounted unit. Costs range from about $120 to $230. **Contact Manufacturer: Ideal Crane Co., Inc., P. O. Box 516, Wichita Falls, Tex., for details on cranes.**



Portable process dynamics recorder

... now being produced is a trailer-mounted unit that can be used to gather data from an operating process and obtain a record of the information in digital-tape form for computer analysis. The PDR-1 instrument accepts the output of transducers measuring temperature, pressure, flow, level, stress, and so on. It does this directly and linearizes scale factors and filters data prior to recording on magnetic tape.

The instrument can sample five separate channels of information at sample speeds up to 40 a second per channel. It can also accept 60 individual signals and record them at rates up to 2½ seconds a scan. **Contact Manufacturer: Southwestern Industrial Electronics Co., A Div. of Dresser Industries, Inc., P. O. Box 13058, Houston, for details on PDR-1 recorder.**

●

Hydraulically powered tongs

... just developed for casing, drill pipe, and sucker rods are designed to give faster, more-powerful, and more-uniform makeup than possible with older types. The tongs are equipped with torque-gage controls to help obtain uniform makeup. The jaw action is designed so that the tong will not slip on tool joints or under high torque makeup, yet will not crimp the pipe.

The casing tong will handle casing sizes from 5½ to 10¾ in. without the use of the cathead or spinning rope. Torque rating ranges from 1,500 to 10,000 lb.-ft.

The sucker-rod tong has a unitized jaw assembly that fits ⅝, ¾, and ⅞ in. rod sizes without change and permits fast jaw change for other sizes. Its torque rating ranges up to 1,500 lb.-ft. **Contact Manufacturer: Byron Jackson Tools, Inc., Box 2017, Terminal Annex, Los Angeles, for details on power tongs.**

●

New fire-resistant paint

... called Fire-Poof snuffs out flames and eliminates smoke chemically. When applied to metal surfaces, the paint prevents rust and corrosion, and eliminates sweating on pipes, the manufacturer claims. The paint comes in an assortment of colors, and is available in both exterior and interior finishes. **Contact Manufacturer: Nor-Chem Products, Inc., 27 Haynes Avenue, Newark 12, N. J., for details on Fire-Poof paint.**

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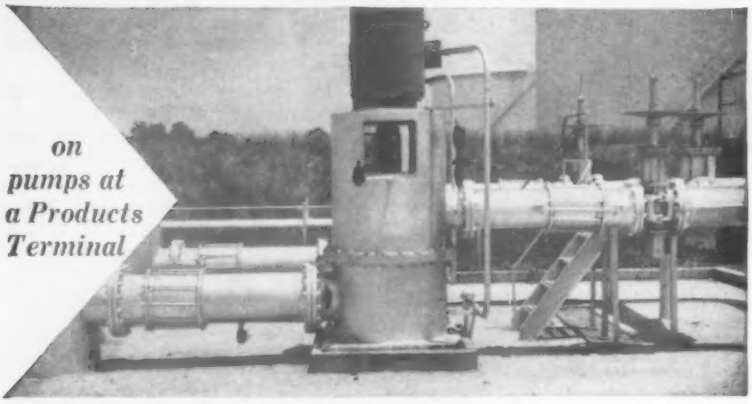
Dresser® Couplings—



on pumps at a Products Terminal

easy, bottle-tight...

on filters and pump lines

safe, permanent joints!

Dresser Couplings are easily installed and bottle-tight for life! The specially compounded Dresser Gasket provides rugged "give and take" to absorb vibration, settlement and other stresses that might cause damage. And there's no pipe threading. With plain end pipe, any workman can install Dresser Couplings in an average two man-minutes per bolt *using only a wrench.* And even with pipe deflection up to 4°, you still get a perfect Dresser-Coupled joint. Send for Dresser Catalog No. 531; it contains more detailed information and complete specifications on *all* Dresser Couplings, Fittings and Pipe Repair Products.

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New Literature

Equipment, systems, and controls

. . . for the process industries, are featured in new Bulletin B-I-F 5-1, now available. The eight-page literature contains information on differential producers and process instrumentation, including flow tubes, venturi tubes, flow and insert nozzles, a meter for continuous weighing of bulk dry materials, and telemetering systems for remote metering and control of processes.

Omega feeders for controlled feeding of solids and liquids are included: gravimetric and volumetric types, batch and continuous feeders. The bulletin describes two component blenders for continuous in-line blending, panel blenders for high-rate volumetric blending of many liquids, additive systems, and pumps for automatically proportioning of additives, slurries, etc. **Contact Manufacturer: B-I-F Industries, Inc., 345 Harris Avenue, Providence 1, for Bulletin B-I-F 5-1.**

Plastic tube protectors

. . . that extend the usable life of oil tubes and increase the life of new ones, are detailed in new Bulletin P-335. Available in three plastics—nylon, polyethylene, and phenolic resin—the protectors resist corrosive, chemical, and fungus attack, are impervious to oils and greases, and will withstand temperatures up to 250° F., the bulletin reports.

The four-page publication contains photos, installation instructions, cutaway drawings, sizes, and recommended applications. **Contact Manufacturer: Crane Packing Co., Dept. OT-4, 6400 Oakton Street, Morton Grove, Ill., for Bulletin P-335.**

Orifice-flanges Bulletin 422

. . . provides detailed information on threaded, slip-on, and welding-neck flanges in 250, 300, 600, 900, and 1,500-lb. pressure ratings. Specifications on welding-neck flanges are given for both raised-face and ring-joint models. **Contact Manufacturer: Advertising Dept., American Meter Co., 920 Payne Avenue, Erie 6, Pa., for Bulletin 422.**

Packaged fire-tube boilers

. . . are detailed from construction features to final test and startup service, in a 12-page, four-color publication, just off the press. The bulletin con-

cerns itself with package boilers through 600 hp. for heating and processing, steam or hot water.

It illustrates present high standards in modern boilers, and discusses current design trends, burner design, automatic operation, efficiency ratings, and factory tests. **Contact Manufacturer: Cleaver-Brooks Co., 326 East Keefe Avenue, Milwaukee 12, for bulletin on packaged boilers through 600 hp.**

Helicopter rig is disassembled

... into components weighing no more than 4,000 lb., as illustrated in a new, 24-page booklet. Large exploded views on a 16 by 22-in. foldout sheet show components of the first drilling rig designed for transportation into remote areas.

Booklet 503 contains line drawings which show arrangements and dimensions. It includes design details, performance, and specifications of the rig, capable of drilling to a 10,000-ft. depth. **Contact Manufacturer: National Supply Co., Two Gateway Center, Pittsburgh 22, for Booklet 503.**

Good financial design

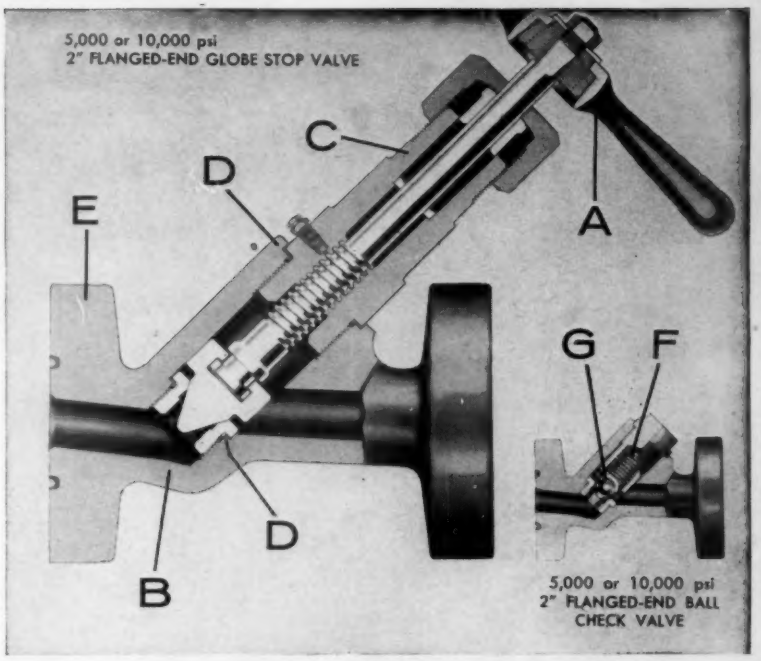
... is the basis for profitable facilities, according to a new 40-page brochure, available from J. F. Pritchard & Co. The literature points out assistance the company lends in economic analysis, process design and evaluation, model construction, complete engineering, procurement, inspection and expediting, field construction, cost control and accounting, and initial operation.

The brochure is packed with photographs which show Pritchard's numerous installations, facilities, and methods. It includes photos of a number of jobs which the designing and construction company has undertaken, along with results obtained. **Contact: J. F. Pritchard & Co., 4625 Roanoke Parkway, Kansas City 12, for Profitable Facilities Through Good Financial Design brochure.**

Electric-hoist selection guide

... covers hoist capacity, speed and height of lift, beam dimensions, suspension types, controls, current supply, and operating conditions. Hoists ranging from ¼-ton to 12-ton capacities are presented in the 34-page publication.

Catalog H-59 gives dimensional drawings and detailed specifications, and describes stationary hoists, electric car pullers, and cabs for trolley hoists. **Contact Manufacturer: American Engineering Co., Wheatsheaf Lane and Sepviva Street, Philadelphia 37, for Catalog H-59.**



New Edward High-pressure Valves for Petroleum Services

New high-pressure, *flanged-end* valves from Edward are designed to give you longer, more dependable service for many petroleum industry applications requiring highest quality in forged steel valves: high pressure heaters, treaters and separators, high-pressure vessel blow-down; headers and flow lines; bypass lines; unloading in compressor stations; blow-out preventer manifolds; throttling services; and many other similar petroleum industry applications.

NEW GLOBE STOP VALVES—There are two new Edward flanged-end, globe stop valves: one for pressures to 5,000 lb WOG at 300F (10,000 psi test); and one for pressure to 10,000 lb WOG at 300F (15,000 psi test). Both valves have the exclusive cross-arm style Impactor handle* (A) that makes closing against high pressure much easier, eliminates need for "cheaters." Valve body (B) is drop forged of chromium-molybdenum alloy steel to exacting requirements for maximum ruggedness and long life under toughest service conditions. The inclined bonnet (C) facilitates streamlining of flow passages, reduces pressure drop and wear-producing turbulence. Metal gaskets (D) and buna-N "O" rings assure tight, leak-proof fit between body and bonnet and between seat and body. Flanges (E) are forged integral with body and faced according to A.P.I. Standard 6B.

New globe stop valve Figs. 5158 and 9158

New ball check valve Figs. 5160 and 9160

NEW BALL CHECK VALVES—In the same pressure classes as the new stop valves, are two new forged-steel, ball check valves. These new check valves have the same general construction plus stainless steel spring (F) and 16% chromium stainless steel ball disk (G) for tight seating. Seat and ball disk are replaceable.

To get the complete story, plus ratings and dimensions, on new Edward flanged-end valves, write for Bulletin 584. Edward builds a complete line of cast and forged steel valves for pressures to 10,000 lbs, with flanged, screwed, socket, or butt welding ends. For additional information, see your favorite distributor, or write Edward Valves, Inc., 1212 West 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. *T.M. Reg. U.S. Pat. Off.

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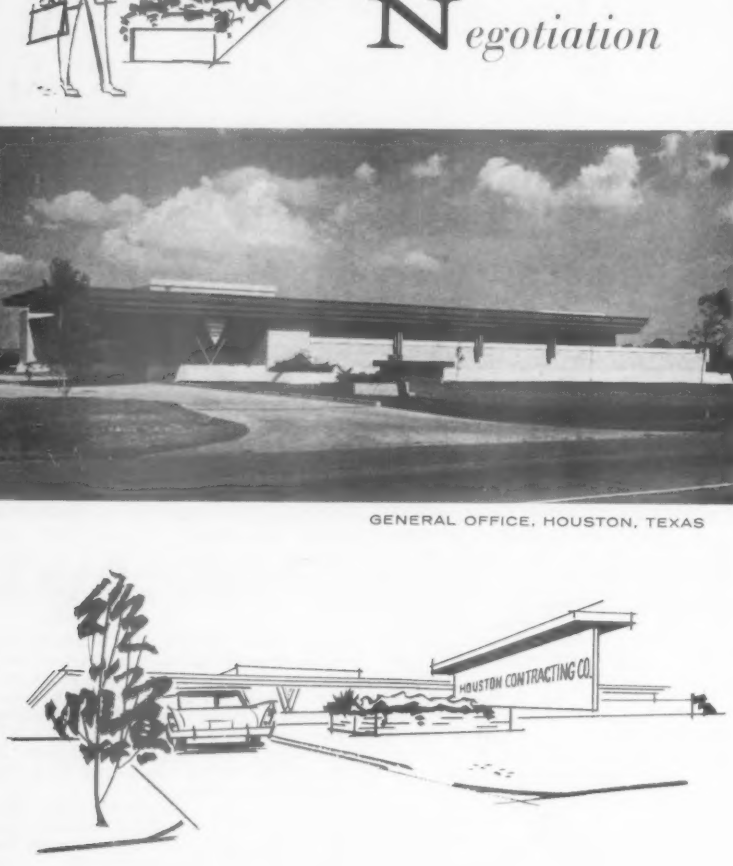

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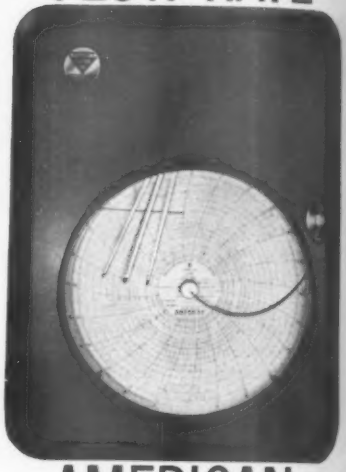

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A-88

ORIFICE METERS

Versatile American® Series A-88 mercury-type orifice meters meet the toughest flow measurement requirements – working pressures to 5,000 psi – interchangeable 10, 20, 50, 100 and 200-inch ranges. Recording meters may be equipped with 0-150° F. standard temperature element. Integrating meters integrate static and differential pressure, providing totalized flow indications. Telemetering equipped meters transmit integrated indications to remote locations.

- Manometer body easily cleaned – does not affect calibration.
- Tamper-proof calibration – simple, positive adjustment of float lever arm length.
- Interchangeable ranges – no manifold piping changes.
- Teflon-packed stuffing box is pressure tight, nearly frictionless, never needs lubrication.
- Teflon-packed pulsation dampener externally adjustable under full line pressure.
- Check valves give positive shut-off for over-range protection.

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Johnston Testers names Cole

. . . to the post of Rocky Mountain area manager with headquarters in Casper. A Johnston employe since 1950, T. W. Cole joined the company in Los Angeles as a tester. He became district manager in Glendive, Mont. the next year, and in 1954 was promoted to Montana salesman.

Last year Cole was appointed senior salesman and was advanced to assistant area manager. Before joining Johnston, Cole was a driller for both F. M. Manning Drilling Co. and Brinkerhoff Drilling Co.

Donald L. Reed named manager

D. L. Reed

. . . of Cooper-Bessemer Corp.'s packaged compressor sales, announces Grant C. Woodard, the corporation's general sales manager. Reed will also keep responsibilities as product manager for gas-engine compressor sales.

Otis Engineering Corp. reports

. . . two executive appointments in its field organization and another in its Dallas home offices.

Raymond Hebert takes over as division manager at Houma, La.; Harold Watson is the new manager for the firm's Belle Chasse, La. division; and Donald M. Taylor, Jr. becomes sales manager for the firm's newly marketed Otis-Maihak bottom-hole pressure and temperature recording instruments.

Hebert, who joined the company in 1953, was division manager in Belle Chasse prior to the appointment. Watson, who also joined the company in 1953, was a sales engineer in Belle Chasse, after assignments in the company's Houma, Falfurrias, and Hobbs branches. Taylor has been with Otis for more than 15 years.

John W. Rife is appointed

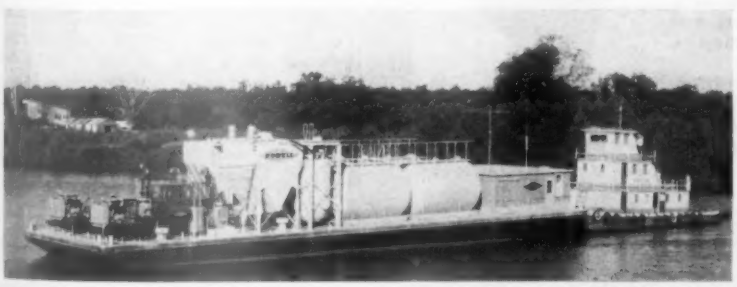
John W. Rife

. . . general manager of Web Wilson Oil Tools, Inc., announces W. A. Wilson, president of the Los Angeles manufacturer of hoisting equipment and production tools for the oil industry. Rife joined Web Wilson 14 years ago. In 1950 he became secretary-treasurer. In 1954 he was elected to the board of directors; and last year he was named assistant to the president.

Mandrel Industries, Inc. buys

. . . all outstanding stock of Well Instrument Development Co., Houston, announces George Quist, Mandrel president. Widco's facilities and personnel will be integrated with Mandrel's Electro-Technical Labs Division, Houston, under the management of D. D. Mize, Mandrel vice president.

Hubert Guyod, formerly with Widco, will join the Mandrel division, where he will be in charge of all matters relating to well-logging equipment and instrumentation.



NEW SERVICE BARGE was built for Dowell Division of The Dow Chemical Co., by McDermott Fabricators. Dowell purchased two of the barges to provide cementing and pumping services on the Louisiana Gulf Coast. In addition to bulk-cement storage, each barge is equipped with a 2,000-gal. acid-storage tank and dual high-pressure pumps powered by two twin GM diesel engines. Air-conditioned crew quarters and a two-way radio system are other features of the barges. Each barge is 120 ft. long and 30 ft. wide. More than 500 oil men attended an open house recently in New Orleans to inspect Dowell's new marine-service equipment.

Pacific Pumps, Inc. lists three

. . . new district sales managers, reports A. F. Canada, vice president in charge of centrifugal-pump sales.

A George Seelke, Jr. becomes manager of the Atlanta district. He joined Pacific Pumps' technical sales department at Huntington Park, Calif. in 1951. Prior to his recent appointment, Seelke was a sales engineer in Houston.

New district manager for centrifugal-pump sales out of the Huntington Park office is Donald G. Jensen. He joined Pacific's technical-order department in 1952. Jensen was transferred to technical sales in 1954 and, prior to his new appointment, was a sales engineer for centrifugal pumps in Los Angeles.

Elton L. (Lee) Watts is the new district manager for centrifugal-pump sales in charge of the San Francisco territory. Watts started with Pacific's technical sales department in 1954 and was transferred to the Los Angeles sales office the same year. He opened the San Francisco office in 1955.

C. E. (Pete) Caldwell appointed

. . . system sales manager for Electrodynamic Instrument Corp. of Houston, President Joe Houghton announces. In this capacity, Caldwell will be in charge of the company's sales of seismic data reduction systems, magnetic recording equipment, and custom-instrumentation systems. Caldwell previously was assistant general manager of Clevite Corp., Texas Division.

Prior to his association with Clevite, Caldwell was with Louisiana Oil Exploration Co. and The Texas Co.

Oil Well Supply Division names

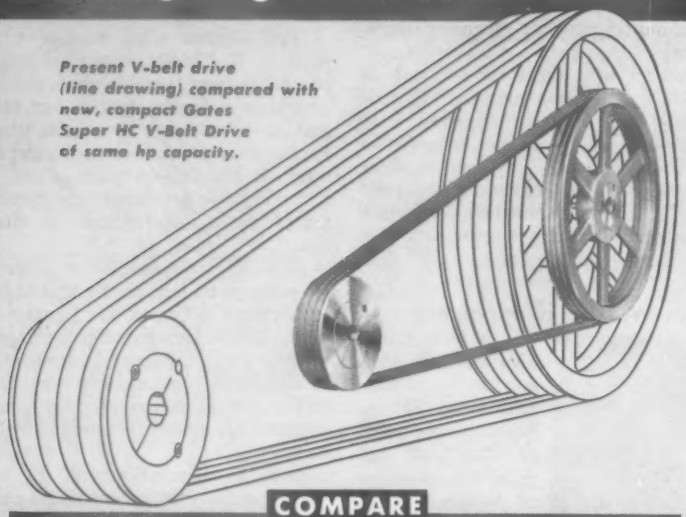
. . . Guy A. Lewis assistant district engineer of machinery and equipment sales and service at Los Angeles, and appoints Herbert R. Trantham, Jr. to store manager at New Iberia, La.

Lewis joined the division in 1947 at Los Angeles. He was transferred to Ventura, Calif. in 1953, and was there prior to his present appointment.

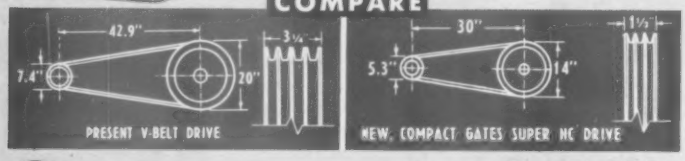
Trantham was employed by Oilwell 11-years ago at Houston. He was transferred to Harvey, La. in 1949 as field representative, becoming store manager in 1951. The following year he was moved to Natchez, Miss. Trantham was named field representa-

Designing NEW DRIVES?

Present V-belt drive (line drawing) compared with new, compact Gates Super HC V-Belt Drive of same hp capacity.



COMPARE



Save up to 20%

with new high capacity V-belt drive

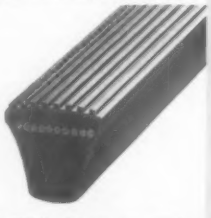
When you change the whole drive—on mud pump, pumping unit, or any other piece of petroleum equipment—remember: The cost of a Gates Super HC V-Belt is as much as 20% less than the cost of present V-belt drives of the same horsepower capacity.

A development of Specialized Research in the world's largest V-belt laboratories at Gates, the new Super HC V-Belt makes possible the most compact, lightest-weight, lowest-cost multiple V-belt drive you can put on any pump!

Cuts drive space as much as 50%

With Gates new Super HC V-Belt, sheave diameters and widths can be reduced 30% to 50%, center distances 20% and more. Bearing load is lightened and total space occupied by the drive may be cut as much as 50%.

"The Modern Way to Design Multiple V-Belt Drives" is an informative handbook on the Super HC Drive, available from your nearby Gates Distributor listed in the Yellow Pages of your phone book.



For NEW drives on mud pumps Gates compact new Super HC V-Belt with the patented ribbed top cuts space required up to 50% and cost as much as 20%.

The Gates Rubber Co., Denver, Colorado
Gates Rubber of Canada Ltd., Brantford, Ont.
World's Largest Maker of V-Belts

TPA 439A

Gates SUPER HC V-BELT Drives

tive there in 1953, and in 1954 was transferred to Eunice, La., as store manager.

John C. Stick, Jr. is named

J. C. Stick, Jr.

. . . assistant manager of logging services for Lane-Wells Co., a division of Dresser Industries, Inc., according to John J. Neale, president of Lane-Wells. Stick will locate in Houston.

S. M. Dippel appointed salesman

. . . for Jones & Laughlin Supply Division at Victoria, Tex., according to W. L. Wolfe, vice president, sales. Dippel is a graduate of J&L's sales-training program.

Wayne Weathers is appointed

Wayne Weathers

. . . branch manager of M. J. Crose Mfg. Co., Inc.'s newest office, located at Santa Fe Springs, Calif., reports Clare G. Miller, company president. Weathers joined M. J. Crose in 1955, working in the firm's Denver shop. He was promoted to manager in 1957, the post he held until the present.

Two changes at Schlumberger

. . . are announced by W. J. Gillingham, president of Schlumberger Well Surveying Corp. Everett F. Stratton, former vice president in charge of operations, has been elevated to executive vice president; and Charles K. Ruddick, previously southeast area manager at New Orleans, replaces Stratton as vice president, operations.

Stratton, who started with Schlumberger as a field engineer in 1936, later served as sales manager in Houston, Rocky Mountain area manager, and manager of the southwest area. He was made vice president of operations 3-years ago.

Ruddick joined Schlumberger in 1936, and worked as a field engineer in several locations in Texas, Oklahoma, and Kansas. He was assistant division manager in Illinois for 4 years before being named assistant manager of the Mid-Continent area at Tulsa. He became area manager in 1952 and finally moved to New Orleans as manager of the southeast area, the post he held until his recent promotion to vice president.

Stockholders change firm name

... from Perforating Guns Atlas Corp. to Pan Geo Atlas Corp. Paul Charrin, company president, noted that the new name would be more appropriate because of the firm's new oil-field services developed over the years, along with expansion to world-wide operations. Pan Geo Atlas Corp. continues as a subsidiary of Chemetron Corp.

Cecil H. Brown promoted to v.p.

Cecil H. Brown

... in charge of sales and services of Oilfield Equipment Corp., according to J. P. Byrd, president of the Denver firm. Brown was OEC's sales manager for more than a year. He formerly was Rocky Mountain district manager for Parkersburg Rig & Reel Co., a firm he worked with for 10 years.

C. R. McMurry named manager

... of the Plastic Applicators, Inc. plant in Harvey, La., according to Joe Deusterberg, the firm's president. McMurry has been with the company 3 years. Before that, he was assistant production superintendent with Southern Natural Gas, and design engineer with Black, Sivalls & Bryson, Inc.

Fort Worth offices are opened

... by Womack-Snelson Advertising, of Midland and Odessa, Tex. At the same time, Bill Philpott was promoted to vice president of the firm and transferred to Fort Worth, where he will direct activities. Philpott has been an account executive with the agency for the past 4 years.

Womack-Snelson Advertising, the oldest advertising agency located in the Permian Basin, specializes in oil-industry advertising and is a member of the Southwestern Association of Advertising Agencies.

Grant Oil Tool Co. acquires

... Cosasco Division, Perfect Circle Corp., according to a joint announcement by William B. Prosser, president of Perfect Circle, and Albert Salvatori, Grant's vice president.

Cosasco, located in El Monte, Calif., manufactures a line of patented access fittings (the original "Scotch"

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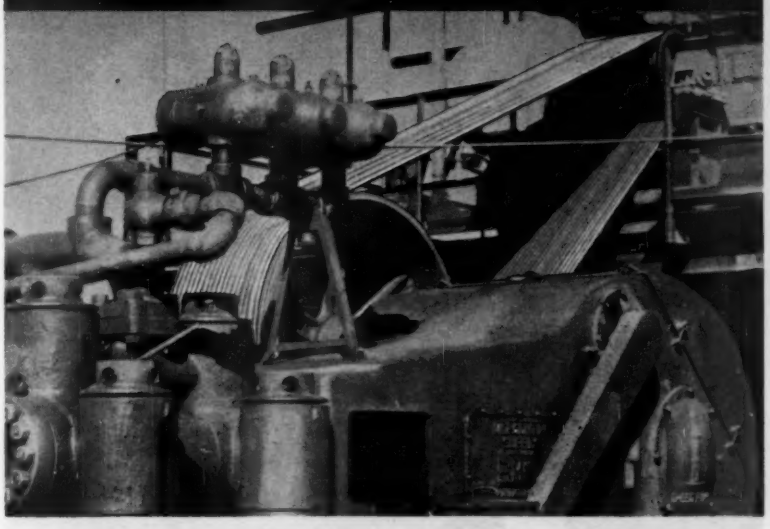

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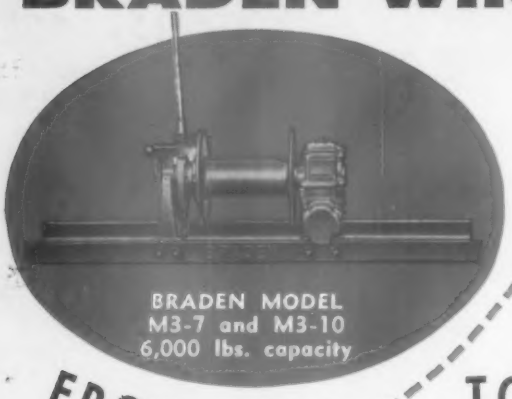

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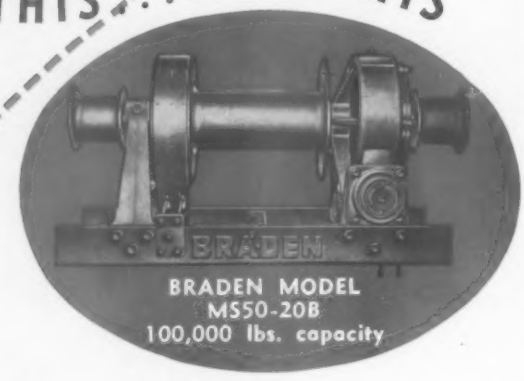

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nipple) which allow access to pressure vessels and lines without shutdown. The fittings are used in both corrosion-survey equipment and in unitized wellheads.

Cameron names W. L. Reynolds

W. L. Reynolds

. . . to the post of sales manager of the Domestic Pressure Control Equipment Division, and promotes R. F. Farmer and I. M. Baker to domestic - international executive sales assistants.

Reynolds came to Cameron Iron Works, Inc., after having spent 12 years in Oklahoma with Magnolia. While in Oklahoma, he was advanced to manager of the company's Mid-Continent district. In 1957, Reynolds moved to Houston as assistant to the sales manager.

Farmer and Baker, who both joined the company in the early 1940's, will serve as executive sales and operational trouble-shooters for Cameron's International and Domestic PCE Divisions.

Charles B. Caldwell is named

C. B. Caldwell

. . . division manager of the West Texas area for Reed Roller Bit Co., announces William E. Scarborough, domestic sales manager. Caldwell succeeds Steve Hazlip. Reed's West Texas division headquarters is in Odessa.

Caldwell joined Reed early this year as regional representative for the Gulf Coast area with headquarters in Houston. His previous experience includes special sales work with Mid-Continent Supply Co., and the presidency of Harrisburg Sales & Service Co.

Wilson Supply Co. purchases

. . . Ft. Stockton Pipe & Supply Co. W. S. Wilson and William Sallee will manage the new operation for the company. The acquisition boosts Wilson's number of store points serving the oil industry to 21.

Douglas J. O'Connor is named

. . . branch manager of Okonite Co.'s newly created Tulsa office. Previously, O'Connor was with Okonite's Atlanta office for 2 years as a sales engineer.

GE engineers say this rig setup means more efficent versatility for . . .

Electric-powered drilling

ELECTRIC-POWERED RIGS may become the operating standard in the drilling industry within the next 2 years, predict General Electric Co. drilling experts.

Many contractors are already realizing more profitable drilling operations through the use of electric drive. Drillers comment that an electric-drive rig has the "feel" of the old steam rigs but with far better performance.

Faster, more efficient drilling; reduced move and rigup time, and easier site preparation are just a few of the many cost-saving advantages offered by electric drive. This rig layout illustrates the flexibility of equipment location possible with electric drive. The drilling area is not cluttered with cumbersome mechanical-transmission components; mud pumps and engines can be located where convenient.

Alaskan contractors work in the long sun

MAKING hole while the sun shines is the adage of Alaskan drillers.

From the first of May through the first week in August, 24 hours of daylight exist in much of Alaska, as contrasted to the months of December and January when light conditions reach a maximum of 2 hours of twilight.

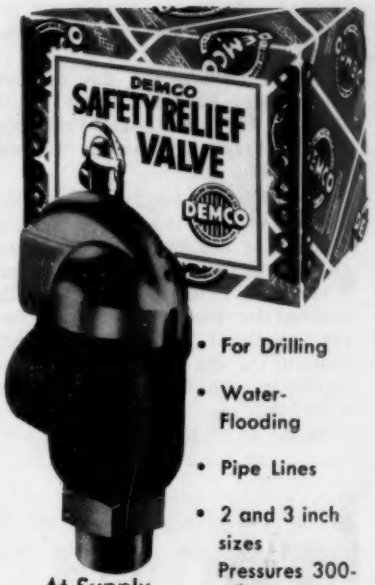
Contractors are taking full advantage of the light prosperity. Look at the activity:

Coastal Drilling Co. has three rigs working:

- Standard-Richfield Swanson River Unit 32-15, Kenai Peninsula, recently spudded, is drilling below 200 ft.
- Union-Ohio well on the Kalifonsky beach road, south of Kenai, is below 12,000 ft.
- Alaskan Consolidated Oil Zappa 1, in the Iniskin Bay area, is reportedly working below 9,000 ft.

Also in the Swanson River area, Mountain States Drilling Co. is working below 7,600 ft. on the Standard-Richfield 12-27.

Another operation Mountain States will handle is the Nulato Unit scheduled on the bank of the Yukon River, approximately 300 miles west of Fairbanks. A National 125 rig, recently purchased from Colorado Oil & Gas Co., is being loaded into barges at Barrow for shipment 1,100 miles through the Bering Strait and up the Yukon River to Nulato. Paul G. Benedum, Pittsburgh, will be the op-



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erator for this venture which will include Benedum and a group of independent operators.

Rowan Drilling Co. has contract for General Petroleum-Great Basins Becharof 1 on the Alaskan Peninsula; spudded July 6, the test is working below 6,600 ft.

A well is scheduled for the Yakataga-Katalla area this year to develop a block of 489,622 acres along the Gulf of Alaska, north of Juneau. Clyde Hall Drilling Co. will handle contract for Richfield Oil Corp., using a National 110 rig, reported enroute to the site. The rig is rated for 20,000 ft. with 4½-in. pipe, and has a 142-ft. mast. The rig features a National 6 micromatic drilling control incorporated in the draw works. It also has a gyrofluid drive for power transmission to the pumps and draw works. An auxiliary rotary drive allows the remainder of power, not needed for the rotary table, to be diverted to two slush pumps.

New Lake Erie platform

Dunnville, Ont., was the site of launching of another lake drilling platform scheduled to work in Lake Erie.

Named "Mr. Pat," the new $60,000 platform was built and will be owned by S. G. Powell Shipyard, Ltd. Scheduled to work for Glacier Explorers, Ltd., Toronto, the equipment left the ways at the Grand River site 2 miles upstream from Lake Erie. The vessel was traditionally christened with champagne by Mrs. Patterson, wife of veteran driller, Pat Patterson, of Patterson & Culver, Dunnville drilling contractors.

This platform is the first designed and built by Powell Shipyard. It will be used to work under contract to Glacier for a gas-drilling program off Point Abina, 6 miles east of Port Colborne. Glacier holds 8,500 acres under lease in the area.

The steel platform provides 30 by 60 ft. of deck space and is equipped with a Patterson & Culver rig, quarters, kitchen, and essential gear.

This will be one of the largest natural-gas drilling rigs built for offshore work in Lake Erie. In drilling position, the four 16-in.-diameter, 67-ft. legs will be lowered into position on lake bottom to lift the platform 10 ft. above lake level. The first venture to be drilled by Glacier will be in 25 ft. of water. Optimum operating depth for this equipment is 50 ft. of water, and its draft is less than 3½ ft. Laden, the steel platform weighs 57 tons.

A design feature of note is the 11 watertight compartments built into the platform, any 3 of which are able to keep it afloat.

AOSC forms new chapter in eastern Kansas

The Association of Oilwell Servicing Contractors, headquarters in Dallas, has formed a new chapter in eastern Kansas, announced James E. Danheim, executive secretary.

The new chapter, which will be called the Eastern Kansas Chapter, was organized in August, Kans., on July 27, 1959, at the Smitherman Cafe.

Henry A. Leake was appointed temporary chapter chairman by Leo L. Kent, first vice president of the national association. Present at the meeting were the following contractors: Johnson Brothers, Wellington; Leo L. Kent, Kent Well Servicing Co., El Dorado; W. B. Miller, Miller Well Service, Virgil; A. M. Bamand and Robert C. Heidrick, Virgil Well Service, Virgil; George Barnard, Barnard Well Service, Madison; Merle Mitchell, Mitchell Well Service, Eureka.

Active members not present at the meeting were: Henry A. Leake, Big Four Well Service, Winfield, and Marion Kinsey, K & S Well Service, El Dorado. James E. Danheim, executive secretary of AOSC, presided over the organizational meeting.

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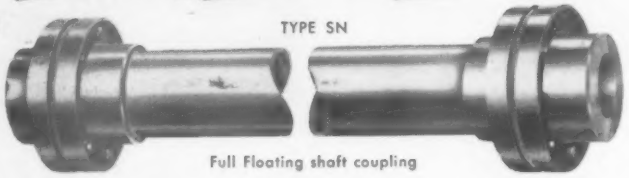

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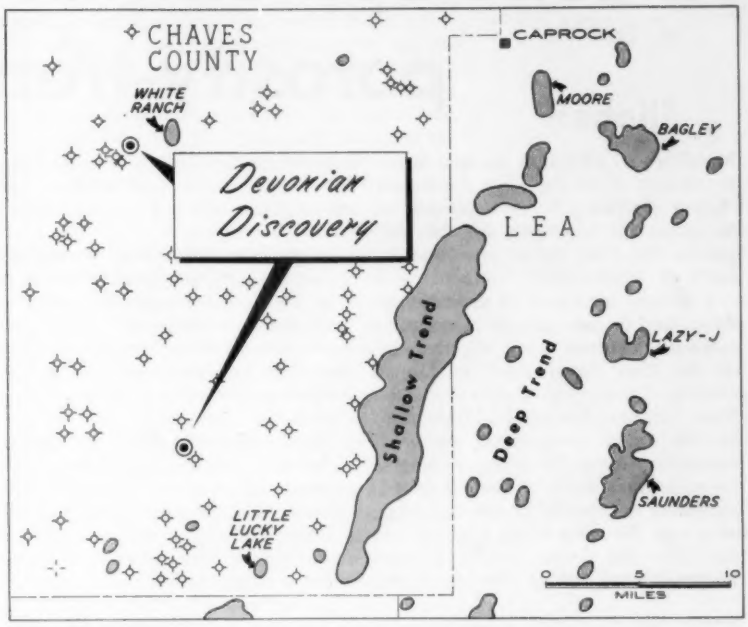
"Dry-hole" country gets two oilers

Successes west of Drickey-Caprock trend may revive deep drilling in Chaves County, New Mexico

BY CARL HOOT



TWO STRIKES have been completed in Devonian rocks in Chaves County, southeastern New Mexico. Geologically, the locations are in a pre-Permian intermediate area. This area has had relatively little pre-Permian exploration.

WILDCATS in Chaves County, Southeast New Mexico, have recently opened two deep Devonian pools. Both wells reported good flowing potentials. Also, both wells are in areas that are studded with dry holes (see map) but most of these have been to 5,000 ft., or under, with a few scattered tests that have penetrated below the Permian.

Southern Chaves County's opener is British-American Oil Producing Co. 1 Honolulu, in NW NE 27-14s-29e. It is 7½ miles northwest of two Devonian wells in Little Lucky Lake field.

B-A's well on completion test flowed 312 bbl. of 55° oil a day through small choke. Final perforations were at 10,222-42 ft. Potential test was run after washing the section with 500 gal. of mud-acid. Flowing tubing pressure was 150 psi. Gas-oil ratio was 570:1. There was no formation water.

No. 1 Honolulu had a relatively thick Devonian section, entering the oil pay at 10,222 ft., and showing gas on drill-stem tests between 10,255 and total depth of 10,360 ft.

Two of a Kind

Seven miles to the north, J. C. Williamson 1 White Ranch, NE NE 1-12s-28e, found the Devonian productive 4 miles southwest of three-well White Ranch field. This test went into the Devonian pay at 8,128 ft. and stopped drilling at 8,140 ft. to avoid entering the water table. Initial tests of open-hole section at 8,128-40 ft. flowed 20 bbl. of 45.5° oil an hour, under maximum flowing pressure of 510 psi. On completion test the well flowed 389 bbl. a day through 20/64-in. choke, with gas-oil ratio of 250:1, and casing pressure of 200 psi.

Speculators have compared the two discoveries with Little Lucky Lake and White Ranch fields. White Ranch has had limited development, but its three wells have produced a total of nearly 500,000 bbl. of oil since discovery by Republic Natural Gas Co. in 1953.

Little Lucky Lake field's flush production and two pays (Devonian and Ellenburger) attracted attention once more to the deep possibilities west of the shallow Drickey-Caprock trend. Texaco, Inc. 1 Perry-Federal, the field opener, in 29-15s-27e was located on a subsurface seismic prospect. It was completed in the latter part of 1958 for 1,053 bbl. of oil a day from Devonian pay at 11,134 ft., and 1,096 M.c.f.d. from the Ellenburger at 12,106 ft. Condensate from Ellenburger gas was 57°. Gas-liquid ratio of well was not reported.

Extension and Confirmation

Texaco then stepped out a half mile to the south of its discovery well and drilled the No. 2 Perry-Federal. In the No. 2, drill-stem tests of the Devonian at 11,054-11,160 ft. flowed as high as 260 bbl. of oil in 2 hours, and at the rate of 66 bbl. an hour between 11,159-11,201 ft. Below 11,201 ft. the bit went into salt water.

On completion, 2 Perry-Federal made a good well in the Devonian and a small gasser in the Ellenburger. Final tests showed 469 bbl. of 60° oil a day through 14/64-in. choke from the Devonian at 11,140-90 ft., and 243 M.c.f.d. gas plus 60 bbl. of salt water from the Ellenburger at 12,070-12,122 ft.

Chaves County's newest Devonian discoveries, pushing out into nonproductive country, should add a little fire to Southeast New Mexico's exploration situation.

Radoil's approach to porosity-trend mapping

BY WILLIAM M. BARRET, President,
William M. Barret, Inc.
Shreveport.

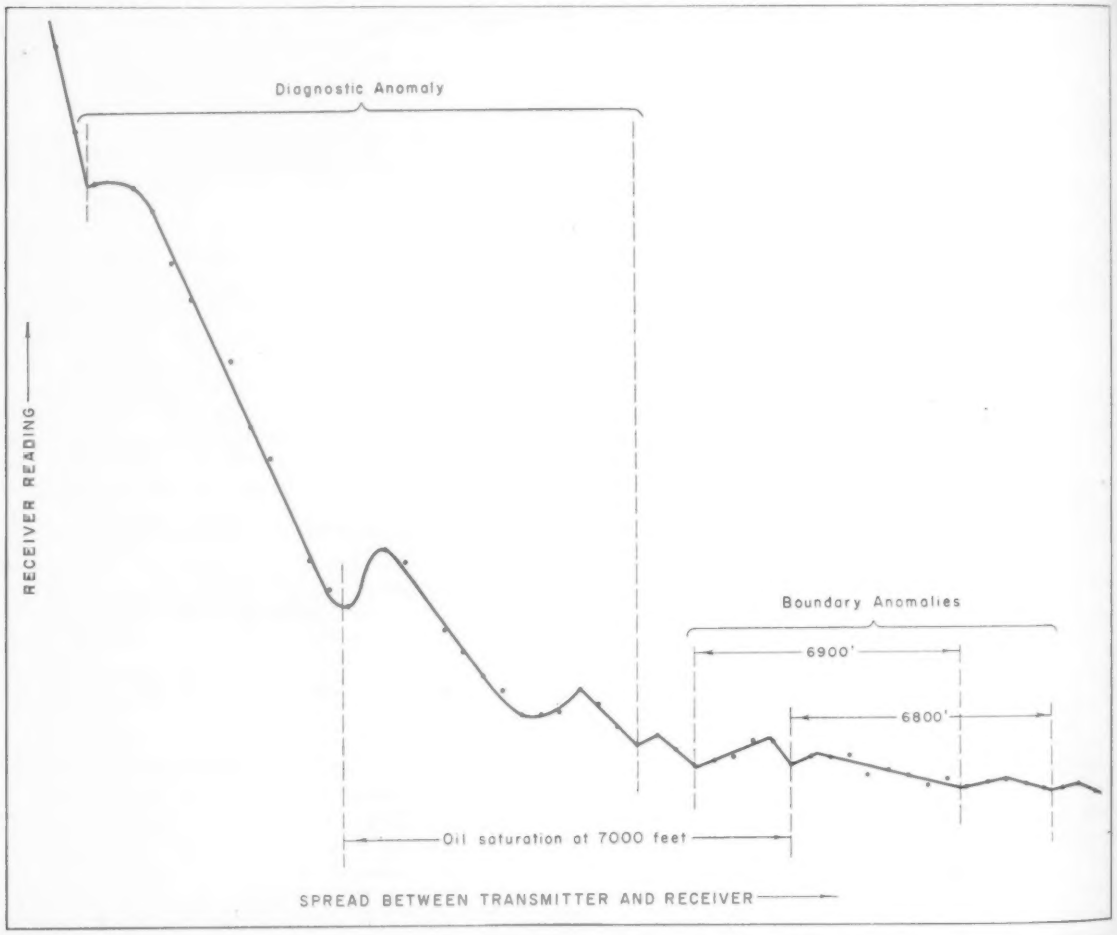
POROSITY TRENDS in the lower Pettet section of the Sligo formation (Lower Cretaceous) have proved to be important reservoirs for oil and gas in the East Texas area and in parts of northwestern Louisiana.

The most important of these trends discovered to date extends in a southeastward direction from slightly east of the East Texas field, in Gregg County, Texas, into Caddo and DeSoto parishes, Louisiana. Production in this trend now covers an area measuring some 50 miles in length by an average width of about 3 miles, excluding the sizable fingers that connect with the main trend. Despite the fact that the porous section at the northwestward end of this trend lies approximately 700 ft. structurally lower than at its southeastward end, no reservoir water is encountered.

No previous delineation of porosity . . . As the porosity trends appear to bear no relation to present structural configurations, they necessarily have been discovered by random drilling, and then extended with the aid of geological studies and not infrequent dry holes.

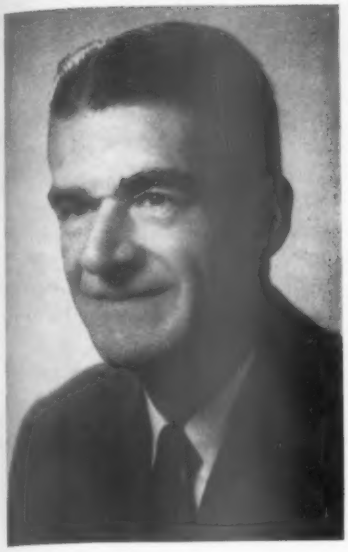
Recognizing the economic importance of the trends, and being aware of the need for a more definite means of determining their presence and course, William M. Barret, Inc., was retained by a client to learn if Radoil surveys might prove useful in mapping the trends. In undertaking the project, the first step was, of course, to select a suitable area for conducting the initial test.

It was found that a wildcat oil well had just been completed in the lower Pettet section in what was suspected to be a virgin trend, although there was no way at the time of knowing for sure that a new trend had been discovered, and if so, there was nothing to suggest the direction and extent of the trend. Accordingly, the site of the new discovery seemed to be an excellent starting point for the Radoil survey, inasmuch as the re-

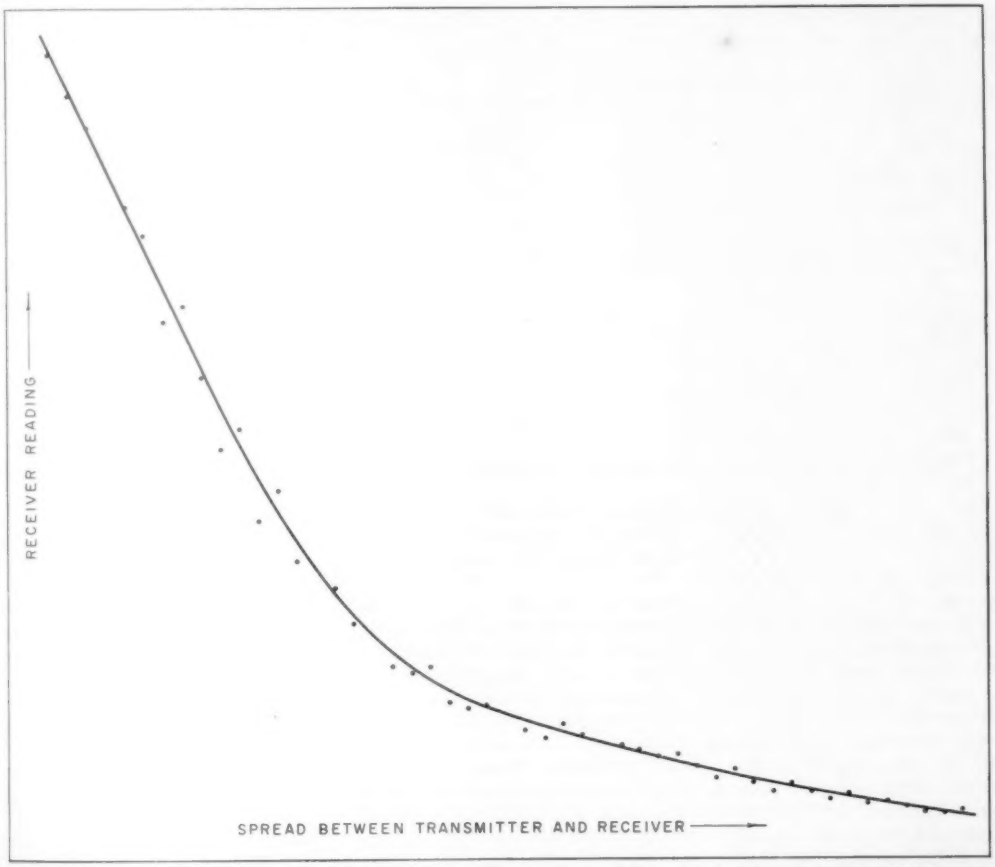


ANOMALOUS PROFILE obtained over the Northeast Hallsville field. The width of the oil-saturated area, as indicated by the profile, is in good agreement with the limits established by subsequent drilling. Fig. 1.

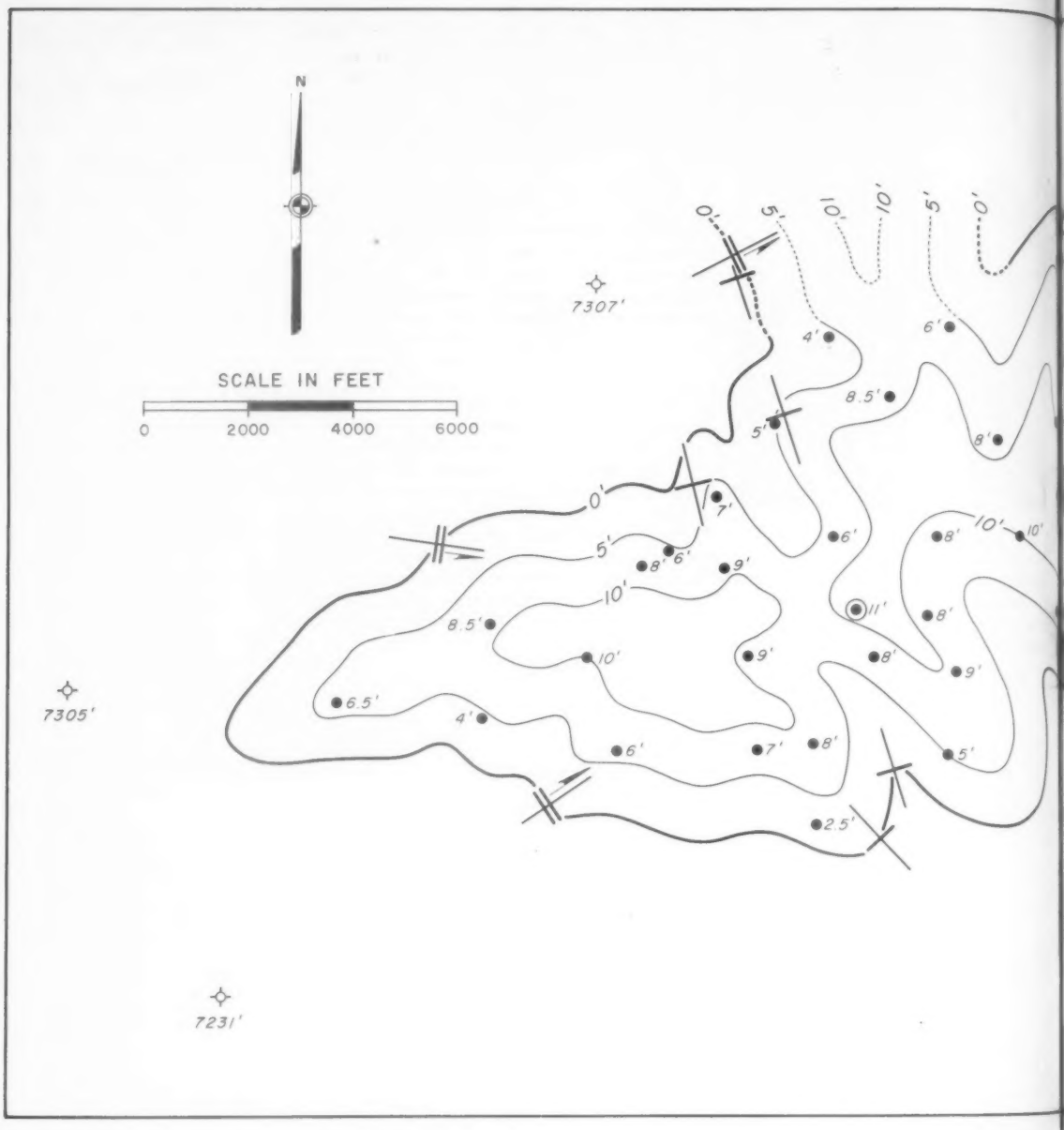
What is Radoil?



"The Radoil method makes use of radio waves to disclose the electrical contrast that exists between oil and salt water, or between oil and sediments, at the boundaries of oil fields. With a fixed transmitter and a movable receiver, each of special design, receiver reading-spread profiles are obtained along traverses overlying the prospect or field under investigation." These are the words of the author, William M. Barret, president of William M. Barret, Inc. Two years ago, Barret used the Radoil method to study a newly-discovered field in Texas, with the object of tracing the reservoir trend. This article tells the results of that study. Barret has been a consulting geophysicist for the past 32 years. He has specialized in the magnetic and electrical methods of exploration and in their application to petroleum and mining problems. He received his pre-engineering education at the University of the South, and his engineering education at Columbia and Tulane Universities. He was graduated from Tulane with the degree of Bachelor of science in Mechanical and Electrical Engineering and the degree of Electrical Engineer. Author of numerous technical papers and articles, he also holds some 50 United States and foreign patents and pending patents covering geophysical apparatus and methods, and several patents in other fields. His memberships in technical societies include the SEG, the European Association of Exploration Geophysicists, AAPG, AIME, the Franklin Institute, the American Association for the Advancement of Science, and the Louisiana Academy of Sciences.



NEUTRAL PROFILE observed in the vicinity of the Northeast Hallsville field. The progressive decline in the receiver reading with increasing separation of the transmitter and receiver, and the absence of diagnostic or boundary anomalies such as displayed by the profile (see Fig. 1) is indicative of the absence of an underlying oil accumulation at the location and depth investigated. Fig. 2.



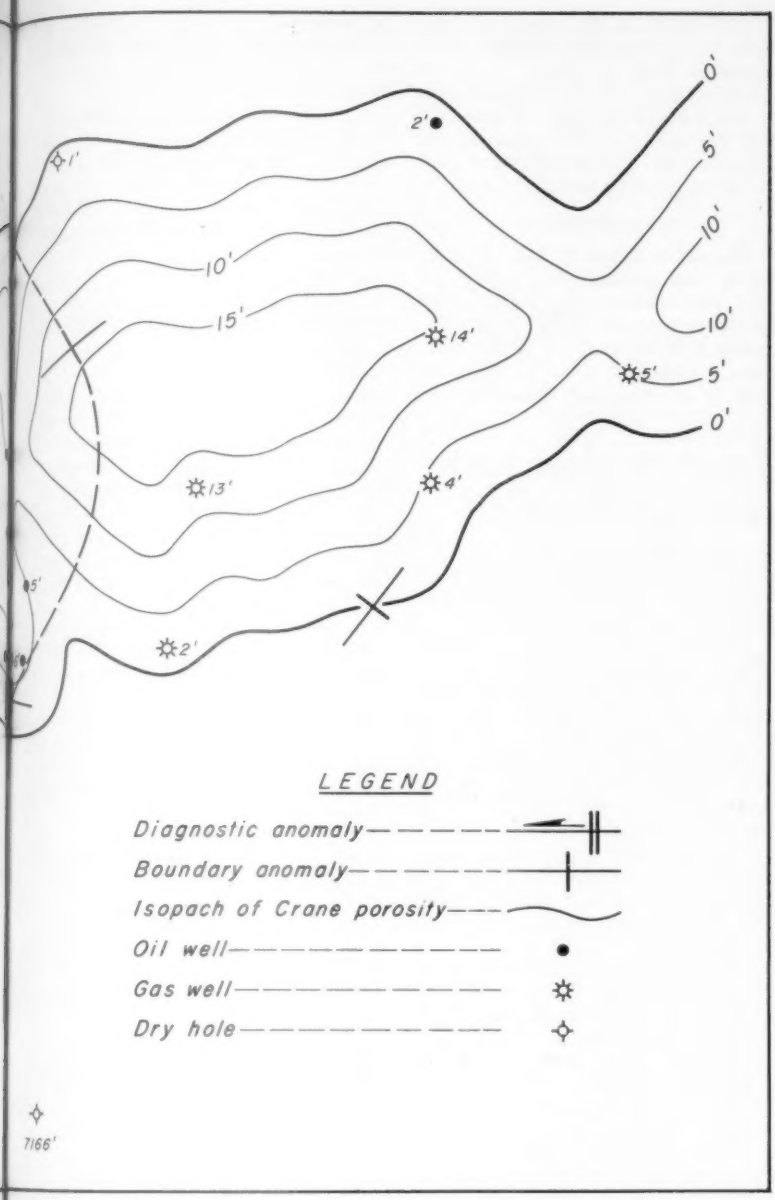
sults of the survey would necessarily be free of any possibility of interpretative bias.

The wildcat oil well referred to above was the Bill Tipton, Trice Production Co., and Amerada Petroleum Corp.'s 1 John White, located in the Martin V. Lout Survey, Harrison County, Texas, some 4 miles southwestward of the nearest producing well in the Woodlawn field. It was completed in December 1956, flowing 340 bbl. of oil per day through perforations between 6,957-66 ft. in what is termed the Crane zone of the lower Pettet section. The producing zone is an oolitic lime with very fine shell fragments. Beginning immediately after the completion of this well, the Radoil survey was finished before the completion of any additional well in the area surveyed.

What is Radoil? . . . The Radoil method makes use of radio waves to disclose the electrical contrast that exists between oil and salt water, or between oil and sediments, at the boundaries of oil fields. With a fixed transmitter and a movable receiver, each of special design, receiver reading-spread profiles are obtained along traverses overlying the prospect or field under investigation.

These profiles may be either essentially smooth, neutral profiles, which indicate the absence of an underlying oil accumulation at the location and depth explored, or anomalous profiles, which display diagnostic anomalies over the side of the oil-saturated area nearer the transmitter and boundary anomalies over the other side of the area. The anomalies accordingly define the margins of the oil accumulation, and the depth of the accumulation may be determined within practical tolerances from the spread characteristics of the anomalies.

In laying out the survey it was decided that its objective could best be realized by attempting to locate the peripheral boundary of the Crane oil saturation at a reasonable number of spaced points, and then to evaluate the validity of the Radoil indications



RADOIL ANOMALIES superimposed on an isopachous map of the Northeast Hallsville oil field and the adjoining southwestward extension of the Woodlawn gas (and condensate) field. Of the wells shown, only the discovery well (circled) was drilled before the Radoil survey. The dotted isopachs are provisional, pending further drilling; the dashed line was reported as representing the approximate location of the oil-gas contact. Fig. 3.

after the productive area was defined by drilling, and after it was established that the oil accumulation occurs in a porosity trend.

The survey was carried out by taking receiver observations along a series of traverses that crisscrossed the area enclosing the new discovery. For comparative purposes, receiver observations also were made along a few traverses in the same general area but considerably removed from the discovery well. The receiver observations observed along the various traverses were plotted in the form of profiles which showed the relation between the receiver readings and their respective spreads, or distances, to the transmitter which propagated the radio waves.

Before considering the profiles observed over the oil-saturated area, it is informative to examine one of the neutral profiles that was secured in an area adjacent to, but outside of, the productive area. Such a profile is illustrated (Fig. 2). It is seen that, in the absence of an underlying oil deposit, the receiver reading declines progressively as the spread between the receiver and transmitter increases, and that the plotted receiver readings do not depart significantly from the smooth curve drawn through the plotted values.

Consider next the profile (Fig. 1) which was observed along one of the traverses that crossed over the oil-saturated area. It is an anomalous profile which displays a diagnostic anomaly and two boundary anomalies. It was concluded from this profile that the oil-saturated area would extend from the diagnostic anomaly to the outer-boundary anomaly (Fig. 1). The inner-boundary anomaly was believed indicative of the appearance or disappearance of a shale streak, or a nonporous section of lime, within the oil-saturated Crane zone.

Confidence in the validity of these anomalies, and in similar ones observed along other traverses, was strengthened by the fact that the spread between the diagnostic anomaly and the transmitter was known from previous experience to be correct for the oil depth of about 7,000 ft., and also, that each of the boundary anomalies comprised a pair of profile "breaks" which were properly separated by a traverse interval that approximated the depth of the oil.

Subsequent development . . . Two years have now elapsed since the Radoil survey was completed, and in that time sufficient drilling has been done in the area to establish the fact that the Crane reservoir may properly be identified as a porosity trend, and to provide a worth-while check on the validity of most of the indications secured in the Radoil survey. A map was made of the locations and status of the wells drilled in and around the producing area. (Fig. 3.) Aside from the discovery well, which is circled, all of the other wells were drilled after the completion of the Radoil survey. The oil-producing area has been named the Northeast Hallsville field, and the gas-producing area to the northeast is referred to as a southwestward extension of the Woodlawn gas (and condensate) field.

Beginning at the Woodlawn field on the east, and extending in a southwestward direction, the course of the porosity trend is clearly displayed by the contours (Fig. 3) which are based on the net thickness of Crane porosity penetrated in the wells. The boundary of the producing area is,

of course, represented by the zero thickness contour.

Also shown (Fig. 3) are the locations of the various diagnostic and boundary anomalies observed in the Radoil survey. Remembering that it was the purpose of the survey to learn if anomalies could be secured defining the boundary of the Crane oil accumulation encountered in the discovery well, the authenticity of the anomalies can accordingly be evaluated by noting how well their locations agree with the zero contour of the isopachous map.

Validity of survey . . . It is seen that for the most part the anomalies are in good agreement with the boundary of the oil-producing area. The one boundary anomaly on the south side of the gas-producing area was obtained accidentally in searching for the edge of the oil accumulation. The dashed line, based on two anomalies located within the field, was interpreted and reported as representing the approximate location of the oil-gas contact, and it is noted that this line does separate the presently defined oil-producing area from the gas-producing area (the one oil well situated eastward of the dashed line produces from a Pettet section above the Crane zone).

Along the northwestward side of the oil field there appear two boundary anomalies which are located 700 ft. and 1,100 ft., respectively, inside of the boundary of the porosity trend. A location error of 700 ft. is not unreasonable in view of the 500-ft. spacing between successive receiver stations. The other and larger error may have been accentuated by the fact that the anomaly involved was observed along a traverse that possibly skirted the edge of the field. Lying somewhat northward of these two indications are a diagnostic anomaly and a closely adjacent boundary anomaly. Based strictly on the present drilling, both of these anomalies would fall about 500 ft. outside of the zero isopach. However, if at least a slight northwestward extension of the field occurs in this vicinity, as suggested by these anomalies, and as indicated by the dotted contours, then this pair of anomalies may be in good agreement with the boundary of the field.

Aside from the several anomalies referred to on the northwestward side of the oil-producing area, two of which will require further drilling for full evaluation, it is seen that the Radoil indications agree well with the boundary of the Crane reservoir, as determined by the drilling to date (April 1959).

Predicated on the results of this brief survey, and on comparable confirmation from a number of other trend surveys, it thus appears that Radoil surveys provide a worth-while tool for aiding in the location and definition of oil accumulations that occur in porosity trends.

Acknowledgments

The author thanks F. Leonard Hargrove, vice president of Norton Oil Co., for releasing the Radoil data here reported, and D. G. Dowell, Jr., geologist of William M. Barret, Inc., who prepared the isopachous map used in checking the Radoil results.

Texas wildcat test recovers Penn oil

A DEEP WILDCAT on the Matador arch, in southern Hale County, West Texas, has recovered oil from the Pennsylvanian around 10,000 ft.

Honolulu Oil Corp. 1 Martha Schultz is being drilled to 11,500 ft. ¼ mile west of the town of Abernathy. First report of oil recovery was in the Pennsylvanian at 9,151-65 ft. Gas surfaced in 15 minutes and recovery was 2,010 ft. of 39° oil. At 9,166-85 ft., recovery was 90 ft. of slightly oil and gas-cut mud, 3,200 ft. of clean oil, and 1,800 ft. of salt water and oil. Flowing pressure on the latter section ranged from 1,545-3,460 psi. Shut-in pressure was 3,565 psi. in 30 minutes.

A drill-stem test at 10,635-10,728 ft., open 5 hours, recovered 837 ft. of 39.5° oil and 90 ft. of heavily oil-cut mud. There was no water. Operators cored ahead below 10,728 ft.

Location in Section 10, Block CK, GC&SF Survey is 4 miles east of a 4,500-ft. dry hole, and 8 miles east of Anton-Irish field which has Clear Fork (Permian) production. It is 7 miles southwest of Lutrick pool, Pennsylvanian discovery.

Oklahoma's Beaver adds two oil areas

The Ridgeway area of Beaver County in the Oklahoma Panhandle has two new Morrow Pennsylvanian oil-producing areas.

Sinclair Oil & Gas Co. 1 Dunn, C SW NE 35-3n-25eCM, flowed 115 bbl. per day on ¾-in. choke from perforations at 7,640-88 ft. The 1 Eyer Unit, C SE NW 34-3n-25eCM, flowed 39 bbl. per day on 20/64-in. choke from Morrow perforations at 7,738-50 ft. The well is also a Tonkawa gas producer at 5,615-22 ft. where it flowed 2,198 M.c.f.d.

Seiling area . . . Other northwestern Oklahoma discovery notes included the extension to the north in this Major County area.

Calvert Drilling Co. 1 Branstetter, C NE SW 14-20n-16w, flowed 96 bbl. of condensate in 19 hours on 12/64-in. choke and 2,496 M.c.f.d. Calculated open flow was 7,180 M.c.f.d. with 22 bbl. condensate per million.

New Oklahoma map available

Designed to conform to the industry's requirements, the Oil Road Atlas, now made available by Research Oil Reports, 904 Commerce Exchange Building, Oklahoma City, or 437 Kennedy Building, Tulsa, can be carried anywhere with convenience. Clearly defined by section, township, and range, this map is useful to everyone.

Principal highways are shown in red and identified by markers, oil and gas fields are shown in color, rivers and lakes are accurately indicated and named, cities and towns are shown. Flexible cover permits rolling without damage, linen cover can be cleaned with eraser. The State of Oklahoma is divided into nine sheets, each sheet legal size. The map is bound with plastic to permit maximum ease in use of each sheet.

New tests assure Texas discovery

Additional drill-stem tests at an Upton County, West Texas, wildcat have assured the discovery of a thick Ellenburger pay section.

The strike is Neville G. Penrose, Inc. 1 King Ranch Oil & Lignite Co., 4½ miles northeast of McCamey in southwestern Upton County. Ellenburger oil was first recovered at 9,920-10,000 ft. Two additional tests to 10,100 ft. recovered clean oil. The well flowed 38.54 bbl. of oil in 1 hour on test at 10,100-48 ft. with no water. Fifteen-minute shut-in pressure was 3,750 psi.

Heaviest flow came on a test at 10,148-86 ft. Gas surfaced in 7 minutes, mud in 17 minutes and oil in 21 minutes, at the rate of 135 bbl. an hour for 2 hours and 4 minutes. Flowing pressure ranged from 2,430-3,870 psi. Shut-in pressure was 4,190 psi. in 15 minutes. Following this test, operations were stopped to check electrical logs.

Location of the multipay discovery is in Section 26, Block 2, MK&T Survey.

Louisiana strike spurs action

LOCATIONS for three additional wells are following a new Wilcox oil discovery by Hunt Oil Co. in southern LaSalle Parish, Central Louisiana.

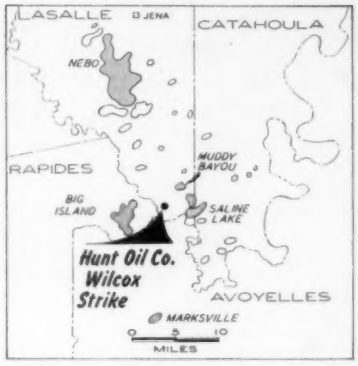
Hunt's discovery is 3 miles west of Saline Lake field, straddling the LaSalle-Catahoula parish line. It is about midway in the gap between that field and the large Big Island field, farther west in northeastern Rapides Parish.

Both Saline Lake and Big Island also are productive from Wilcox sand, as is Muddy Bayou field, 3 miles northeast of Hunt's discovery well.

The latter well is rated good for more than 100 bbl. of oil per day although potential tests have not been taken as yet. Flow estimates are based on a preliminary drill-stem test after perforating the pay at 5,310-14 ft.

This test, through ¼-in. bottom and ⅝-in. top chokes had gas at the top in 30 minutes, and fluid 5 minutes later. Flowing pressure was 265 psi.

Discovery well is on the extensive fee lands of Louisiana Delta Hardwood Lumber Co. It is Hunt's "H-137." New locations are northeast, north, and west of the discovery well on the same lease.



SOUTHERN LaSalle Parish discovery narrows gap in Central Louisiana group of Wilcox fields.

The Big Island-Saline Lake area, extending from northeastern Rapides Parish through the narrow southern neck of LaSalle parish, into southern Catahoula Parish has been a center of sporadic Wilcox exploration for many years. Wilcox also is productive in the expansive Nebo-Hemphill area farther north in LaSalle Parish.

Three California gas tests hit

THE SUMMER drilling boom in California's gas counties recently resulted in four new pool discoveries in 1 week. They included:

... **Contra Costa County.** Trico Oil & Gas Co. scored with a dually completed wildcat in the Willow Pass field. Both zones in the Trico well are labeled new pools. One is producing from 1,910-47 ft. and the other from 1,580-89 ft. and 1,644-49 ft. The latter two intervals are in the same upper zone. Initial production from the lower was at 1,200 M.c.f.d. rate while the upper made 1,800 M.c.f.d. This test is in NE NW 21-2n-1w.

... **San Joaquin County.** The River Island field in this county was given a new pool discovery by Brazos Oil & Gas Co. The Brazos test, 2 Sunray-Brazos-Vistario, found the new pay at 4,095-4,105 ft. Initial production was 2,200 M.c.f.d. through a ¼-in. choke. The well is located on the east edge of the field.

... **Solano County.** G. E. Kadane & Sons were credited with giving the Suisun Bay gas field a shallower pool discovery with a well in NW SW 31-4n-1w. The interval was reported to be at 654-65 ft. No production figures were released by the operator.

... **Sacramento County.** Brazos Oil & Gas Co. released information on its dual-zone new pool discovery made the end of July in the Walnut Grove area. The upper, or Midland zone, at 3,680-3,700 ft., made 1,400 M.c.f.d. through a 13/64-in. choke. The lower, or Locke zone, at 7,702-22 ft. and 7,776-86 ft., made 1,350 M.c.f.d. through an 11/64-in. choke.

Montana wildcat reports oil shows

A shallow wildcat 3 miles west of production at Pondera field in Teton County, Montana, has recovered oil and gas on drill-stem tests of the Sun River (Madison) formation.

Cardinal Petroleum and National Bulk Carriers 1 Campbell, SE SE NW 4-27n-5w, recovered 60 ft. of clean oil, 120 ft. of gas-cut mud, and 60 ft. of mud-cut, gassy oil on test at 2,475-96 ft. On the test, gas flowed in 3 minutes, at the rate of 280 M.c.f.d.

On test at 2,457-78 ft., the well gaged 90 M.c.f.d. of gas and recovered 60 ft. of gas-cut mud.

Top of the Run River was logged at 2,463 ft. Total depth is 2,496 ft. Operators ran casing to 2,489 ft. for open-hole completion attempt.

Michigan prospects spark drilling

TWO NEW oil pool prospects, a probable Niagaran reef gas discovery, and a pool confirming well sparked Michigan's resurging oil developments.

Turner, Hartman and McClure 1 Mathews SE NE NW 20-5s-7w, 25 miles west of Scipio Trenton field, Branch County, logged Trenton at 3,114 ft. and logged good show free oil through hole full of load water at 3,310-15 ft. Cable tool hole will be deepened.

- C. W. Moskowitz 1 Miller, SW SW NW 28-3n-14e, Macomb County, 5 miles southwest Boyd gas-oil reef field, tested 380 M.c.f. gas at 2,525 ft. in Niagaran. Zone logged at 2,494 with pay at 2,496-2,505 ft.
- Welch and Lucas 1 Adamczak SE SE NW 24-21n-17w, Manistee County wildcat, logged Salina A-2 section at 3,562 ft., and had core gas and oil saturation near 3,640 ft. Test was drilled primarily on the strength of a 3,800-ft. salt well drilled earlier this year that showed gas and oil in the A-2 on a drill-stem test, but was cased off for salt completion.
- Apparently confirming a sizable Dundee zone oil field, Gulf Oil Corp. 1 Mell, NE SE NW 19-21n-7w, Missaukee County, cored 20 ft. oil pay 4,056-67 and 4,067-77 ft. Test is a 1,320-ft. north offset to Leonard Oil 105-bbl.-day Dundee discovery this year and first follow up well.
- Apache Oil Co. 1 Krebs, SE SE SE 27-2s-4w, Calhoun County, 2 miles north stepout to Albion Trenton field, drilled Trenton dry at 4,576 ft.
- A blow to prospects in the Hanover play, Jackson County, developed with Palmer and McClure 1 Rountree, NW NW SW 16-4s-2w, dry in Trenton at 4,375 ft. Test is located 1 mile southeast of Bell and Gault 1 Bissell, SE SW NE 8-4s-2w, which is still deepening in Trenton at 4,105 ft. without oil but gaged up to 17 M.M. c.f. gas between 3,989 and present depth.

Next Week

How complex can a structure get?

These workers are natives of nation which offers a new frontier, but . . .

Libya holds promise — and problems

LIBYA is a land of intrigue, promise, and problems for the oil men exploring her sand-blown lands. Much has happened during the past 8 years since this former Italian colony was given her independence.

As an oil-producing country, Libya is even more of a youngster. Earlier this year Esso Standard (Libya) made a startling discovery in its Zelten 1-6, in northwestern Cyrenaica Province. This wildcat tested 17,500 bbl. per day from a 205-ft. zone in the Paleocene at 5,460-5,665 ft. (OGJ, June 1959, p. 85). A 4½-mile-south offset, the Zelten 2-6, is working below 4,700 ft.

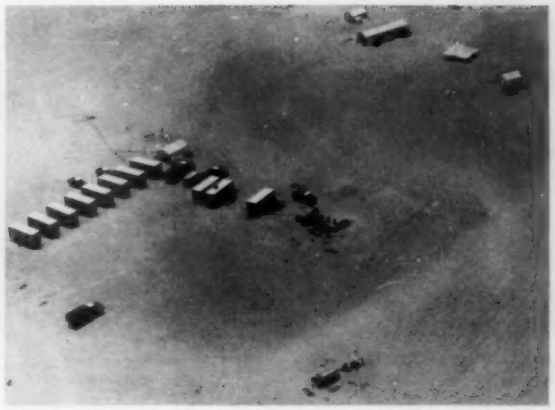
The significance of the Zelten find indicates that Libya may eventually compare favorably with Middle East production. Close to European markets, its potential is enhanced because, unlike the Middle East, it isn't necessary to transport the crude to Europe via the Suez Canal.

A potential of high reserves appears present. Neighboring Algeria to Libya's west has good proven production. The discoveries have continued east into Libya and most of the wells drilled in the country have found several shows in each test. Not all the wells with logged shows of oil and gas (though productive) have been commercial. Look at the Fezzan province in the southwestern portion of the nation, for example; two wells making up to 500 bbl. per day each were abandoned because the structures were considered too small for economic development.

MAP OF LIBYA shows what has happened in the past 19 months. Greatest concentration of discoveries is the three Oasis wells in the Sirte basin.

Geology . . . Much of the country is comprised of a thick section of marine Paleozoic sediments. These formations are comparable in character, content, and extent to the oil-bearing Paleozoics of the North American interior. The post-Paleozoic strata of North Africa are generally continental and these later deposits stood high above sea level during the time of deposition. The most noticeable exceptions are certain basins on the African continent. The Sirte embayment in North Central Libya is an

AMERICAN DRILLER and his two Libyan helpers are making hole for seismic charges in the sandy wastes.



TRAILER CAMP provides utmost in comfort while combating the desert heat. These quarters are air conditioned.

area that produces from Mesozoic-Cretaceous formations.

Libya's Exploration Progress

Exploration actually started late in 1953 when six companies conducted surface-geology work that continued through 1954. The following year the government drafted a petroleum law that was passed June 19, 1955. This opened the gates for concession grants, and applications were filed.

At the offset, 15 firms received 54 blocks. In these first permits, 50 were for tracts along the coast of the Mediterranean Sea in the provinces of Tripolitania and Cyrenaica. The remaining four were in Fezzan Province in southwestern Libya, adjacent to Algerian production. A CREPS (Compagnie de Recherches et d'Exploitation des Petroles au Sahara) well in the Edjele field, 1,000 ft. across the border in Algeria, tested 400 bbl. daily in the Carboniferous at 1,475 ft. This undoubtedly sparked initial interest in the Fezzan area.

SEISMIC surveyor takes shot on Libyan rodman.

Under provisions of the concessions, the holders were required to begin exploration work on their blocks within 8 months. Exploration activity flourished. In the first year the only geophysical work done was gravity work and an extensive aeromagnetic

RECORDING TRUCK has oversized wheels and four-wheel drive to navigate sand. This geophysical crew is made up of Carter Oil Co. personnel, on loan to Esso (Libya).

A COMPLETE TOWN on wheels are these trailers which include quarters, dining room, kitchen, offices, and laundry. It has its own electric power supply, gas, and can drill either water wells or haul water in tank trucks.

survey of the Sirte basin. Prime effort continued with concentration on surface geology. No wells were drilled in 1955.

The year 1956 saw the first test in the country drilled in the Cyrenaïca highlands near the coast between Bengasi and Tobruk. Abandoned at 9,372 ft., this wildcat, the Libyan-American 1-18 Gerdes el Abid, encountered no shows, and it was considered to have been drilled entirely in the Cretaceous, which is exposed at the surface.

New exploration methods were introduced in the Libyan campaign. Seismic crews came in for the first time. Meanwhile surface geology nearly doubled. Gravity work increased twenty-fold. Only magnetics showed a decrease in number of party-months.

Four unsuccessful tests were completed in 1957 for a total of 29,186 ft. Four rigs were running in the country. Drilling ventures were located mostly in Fezzan and in the Sirte basin. Esso operated in the former, and Oasis Oil Co. of Libya, along with Mobil Oil of Canada, were testing the basin. South of Tripoli in Block 34, D'Arcy was exploring a new sector with its Castel Benito 1 test. Four more wells were still drilling at the year's end.

All types of survey activity soared over previous year's figures. Surface geology doubled; seismic party-months increased from 24 to 106, and was one-third the total of geological crews. Gravity tempo picked up from 65 to 151 party-months, and both air and ground magnetic work increased to seven times its former pace. A tool new to Libya, the core drill, was introduced.

More concessions were granted and among these were some newcomers: Gulf Oil, Ed Pauley interests, Elwerath of Germany, and AGIP of Italy.

Turning point . . . 1958 started with new excitement in the form of Esso's discovery at the Atshan B2-1 test in Fezzan. After two failures in this locale, the B2-1 tested 500 bbl. daily at 2,100 ft. in the Devonian. The 45° API oil was later considered present in noncommercial amounts. Following this January find, Oasis Oil Co. of Libya and CTP-L (Compagnie des Petroles Total [Libya]) made three more discoveries:

- Oasis Bahi A1-32, completed in July 1958 tested 700 bbl. daily 39° oil at 5,822-54 ft. in Cretaceous.
- Oasis Dahra B1-32, completed in November 1958, tested 480 bbl. daily 36° oil at 3,758-3,808 ft. in Cretaceous.
- CPT-L Tahara B1-49, completed December 1958, tested 100 bbl. daily 45° oil at 4,600-75 ft. in Carboniferous. Another zone at 7,573 ft. in the Ordovician tested gas and some oil.

Interest in the Cyrenaica highlands faded after Libyan-American drilled three dry holes in Block 18 east of Bengasi. New focal points were the Sirte basin and Fezzan area. Oasis had now successfully completed its first two wildcats in Block 32.

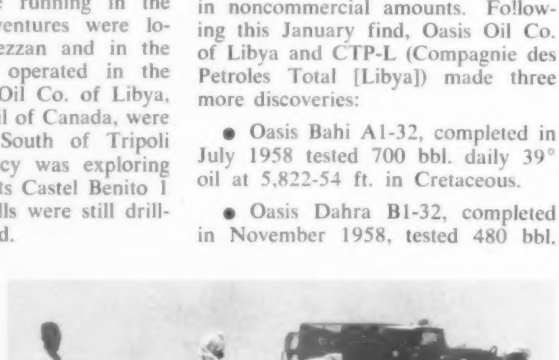
A new trend had been established to the west in Fezzan. In addition to the Algerian near-border fields of Edjele, Zaraitine, and Tiguentourine, the Libyan extensions of the trend now reached from Esso's Atshan to CPT-L's Block 49 pool opener.

No diminishing of survey work occurred in 1958. To the contrary, more work was done than ever before. Surface geology jumped to 407 party-months, seismic more than doubled to 233 party-months, gravity leaped to 253 party-months, magnetic work fell off a little, and core drilling maintained a constant rate. Total party-months of all methods approached 1,000.

The drilling figures are noteworthy. Total footage increased from 29,186 ft. in 1957 to 156,868 ft. in 1958, with nine rigs running. Total number of wildcats drilled was 25—of these four were discoveries. One development well was drilled and abandoned.

A record year . . . 1959 continues a banner year. During the first 7 months, 6 new discoveries have been made (See map). These are:

- Royal Dutch-Shell Bir Tlacsin A1-70, southwest of Tripoli, had a test of 1,000 bbl. daily at 8,909 ft.
- Esso Zelten 1-6, east of the Oasis wells, was tested for 17,500 bbl. daily of 37° oil in a 205-ft. zone of the Paleocene at 5,460-5,665.
- Oasis Dahra F1-32 in Sirte basin tested 30 bbl. hourly of 41° oil.



LIBYAN helpers are picking up the cable during seismic shooting.

TRANSPORTATION and supply are two major factors in Libyan exploration. Essential to the operation are the plane-truck teams.

- Gulf Libyan Emgayet 1-66 extended the Fezzan trend northwest with its 750-bbl. well at 4,100 ft. Gravity was 35°.
- Texas Gulf Mobruk 1-17 had three producing zones: 90-ft. pay at 3,100 ft.; 30 ft. of pay at 5,711-41; and 4 ft. at 5,774-78 ft. The three zones had potentials of 28, 29, and 22 bbl. hourly.
- American Overseas Petroleum, Ltd., Beda 1-47 made 1,282 bbl. daily at 4,000 ft. The 36°-oil find was located southeast of the Oasis wells.

Problems

Glittering as Libya appears, it presents headaches that are numerous and diverse. The problems are physical, psychological, political, and economic.

Climate extremes, vast distances, low population density, and material supply create some of the more prevalent obstacles. Not only does the sand blow high and fiercely, but it is estimated that 3,000,000 active mines exist in the country. Recent figures are not available, but during 1956 approximately 168 crew-months were spent in mine clearance. This aftermath of World War II has hampered operations no small extent.

The Libyan Government has indicated changing sentiments towards the foreign business in its country. Most recent suggestion of possible things to come is the new duties imposed on some luxury goods. The import taxes have in some instances been doubled.

Costs are extremely high in Libya. Most equipment is customized to overcome weather and terrain features. The mere remoteness of the areas operated in provides transportation difficulties. Men, equipment, and material, for the most part, are imported. Every operation must be equipped with a semi-permanent camp due to sparseness and inadequate facilities at the few existing villages. Pipelines will need to be laid before Libya will be a producing country. All this will take time, technology, and money—much money!

Promise

Despite setbacks in operating conditions along with other factors, Libya will come to the fore as a major producing area. Why? The potential and the rewards are there. It will take time and effort. Six good strikes in the first 7 months of 1959 are reason enough for further activity. After all, how many active areas are capable of producing 17,500 bbl. daily from one well?

Acknowledgment

The pictures were provided through the courtesy of Carter Oil Co.

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Further exploration slated for Texas' Terrell

Terrell County, in the Val Verde basin area of West Texas, is in line for further deep exploration.

Humble Oil & Refining Co. 1 Annie Spencer has been spotted in the SW SW Section 68, Block B-2, CCSD& RGNG Survey. Proposed depth is 14,100 ft.

The test is 10 miles southwest of Sheffield townsite, 14 miles northwest of the Brown-Bassett area, and 1¼ miles southwest of a Wichita Albany producer.

Shell Oil Co. and Humble 1 Smith, 5½ miles southwest of Sheffield, has been shut in without taking potential tests. The well had gas in the Devonian and Strawn formations.

Midland dual strike runs final tests

Final completion tests have been made at a dual gas-condensate discovery in Midland County, West Texas.

Texas Pacific Coal & Oil Co. 1-B McAlister, 2 miles southeast of Germania in northeastern Midland County, flowed 170 M.c.f.d. plus 22 bbl. of 57° condensate from the Strawn at 10,354-64 ft. Devonian potential was 3,600 M.c.f.d. plus 255 bbl. of 54° condensate, from perforations at 11,368-11,432 ft. Total was 11,548 ft.

Location is in Section 41, Block 37, T1S T&P Survey. Nearest Strawn production is 5½ miles to the southwest in the Azalea multipay field, and nearest Devonian production is approximately 3 miles to the south-southwest in the same field.

Lincoln gasser is new zone discovery

Top of 70 ft. of Red Fork section yielded 4.7 M.M.c.f.d. of gas at an eastern extension of old Viola production at North Wellston field, Lincoln County, Oklahoma.

Laffoon Oil Co. of Oklahoma City had a blowout in its 1 Lee when it entered the Red Fork sand at 4,519 ft. The well was killed with 450 sacks of mud before the entire sand body was drilled.

Fifth big well for shallow field in Texas

Southeast Noelke - Lower Queen field in Crockett County, West Texas, gained its fifth producer. Like the other wells in this field, this one flowed a high potential from shallow pay.

The new well is Fred Turner, Jr. 7-BB Shannon, in Tract 23, League 4, Archer CSL Survey, 6 miles southeast of Iraan. Calculated daily rate of flow was 2,384.6 bbl. of 31° oil, based on a 4-hour gage of 397.44 bbl. through ½-in. choke. Pay is the Lower Queen sand at 1,596-1,615 ft.

The original well in this pay blew out and flowed oil over the countryside for 24 hours. While flowing out of control it was estimated as making upwards of 10,000 bbl. of oil a day.

Second producer confirms new field

A SECOND PRODUCER confirms the recent new pool discovery in northwest Green Township, Wayne County.

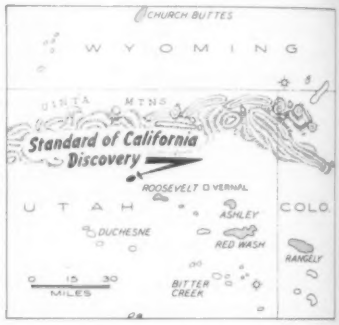
Ohio Fuel Gas Co. 1 I. D. Ramseyer, Section 7, logged the Clinton at 3,473-90 ft. Natural gage was 297 M.c.f. and after fracture, 1,390 M.c.f. with a 90-hour rock pressure of 1,250 psi.

Darrel Blanton continues to be successful in developing production east of the old Richland pool in Swan Township, Vinton County.

The latest gasser, 5 P. L. Bray, Section 22, was reported to have made 1,280 M.c.f. natural in the Clinton from 2,833-51 ft. After fracture, well blew open for 35 minutes and gaged 16,030 M.c.f. with rock pressure of 825 psi.

Deep tests . . . Ohio Fuel Gas Co., East Ohio Gas Co., Wiser Oil Co. 1 M. E. Warner, Lot 42, Granger Township, Medina County, still drilling at 6,038 ft.

Natol Corp., W. E. Shrider, Oxford Oil Co., Ohio Fuel Gas Co. 1 H. Johnson, Lot 32, Monroe Township, Coshocton County, temporarily shut down at 4,450 ft. with caving difficulties in the shale section between the Medina and Trenton formations.



NEW WILDCAT oil well in Duchesne County, Utah, extends Uintah basin trend of fields northwestward.

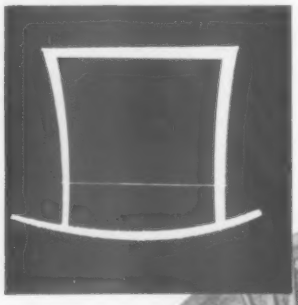
Drillers in Utah hit on third try

THE THIRD ATTEMPT by Standard Oil Co. of California and its partner, Western Operations, Inc., to find production on their Uintah-Ouray block in Duchesne County, northeastern Utah, has proved the charm.

Their 3 Uintah-Ouray, in 5-1n-2w, produced at the rate of 350 bbl. of oil daily while testing three perforated intervals in Eocene sands from 10,000 to 12,000 ft.

Location is 16 miles northwest of Roosevelt and nearest oil field. It is the first productive well on the north side of Uintah basin. Standard of California has 60,000 acres under lease in the area.

The well was drilled to total depth of 13,354 ft. With surface elevation of 7,349 ft., it topped the Wasatch formation at 11,100 ft., and Cretaceous at 12,264 ft.



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McCOMB oil discovery joins list of Tuscaloosa fields in southern Mississippi's Pike and Lincoln counties.

Revived Tuscaloosa play gets new hit

PROLIFIC Tuscaloosa sands have been found productive in another South Mississippi discovery.

The new discovery, at the western edge of McComb townsite, in western Pike County, comes in the wake of the proving up of a major Tuscaloosa field at Little Creek, 10 miles northeast on the Lincoln-Pike county line.

It is 4½ miles southeast of Summit field, another discovery in the revived Tuscaloosa play following the discovery of Little Creek early in 1958.

The McComb discovery well, 1 Pope, in 10-3n-7, was drilled as a joint operation by Willis Hughes and Sun Oil Co. It appears to be an important addition to the list of Tuscaloosa fields.

Tested through 9/64-in. choke, it flowed at the rate of 222 bbl. of oil daily in the first 16 hours, registering pressure of 1,100 psi. on the tubing. Open again later after having been shut in for additional storage, it increased its flow to 230 bbl. daily through the same choke.

Flow was with gas-oil ratio of 1,360 cu. ft. per barrel. Gravity of the oil is 37°.

Pay is perforated at 10,882-86 ft., the bottom 4 ft. of indicated 17 ft. of net effective sand. Hole was drilled to 11,238 ft.

Discovery confirms Colorado gas field

Northwestern Colorado's Winter Valley gas field was confirmed at a Continental Oil Co. well, the 7-2 Winter Valley in NW SE 7-4n-98w, Moffat County.

Gas flow was more than 5 M.M. c.f.d. from Dakota Cretaceous. Location is about ½ mile southwest of the field discovery well which made 2,120 M.c.f.d. from Dakota perforations at 5,420-50 ft.

New wildcats scheduled in northern New Mexico

Four regional operators have announced new wildcat tests for San Juan and Rio Arriba counties, New Mexico.

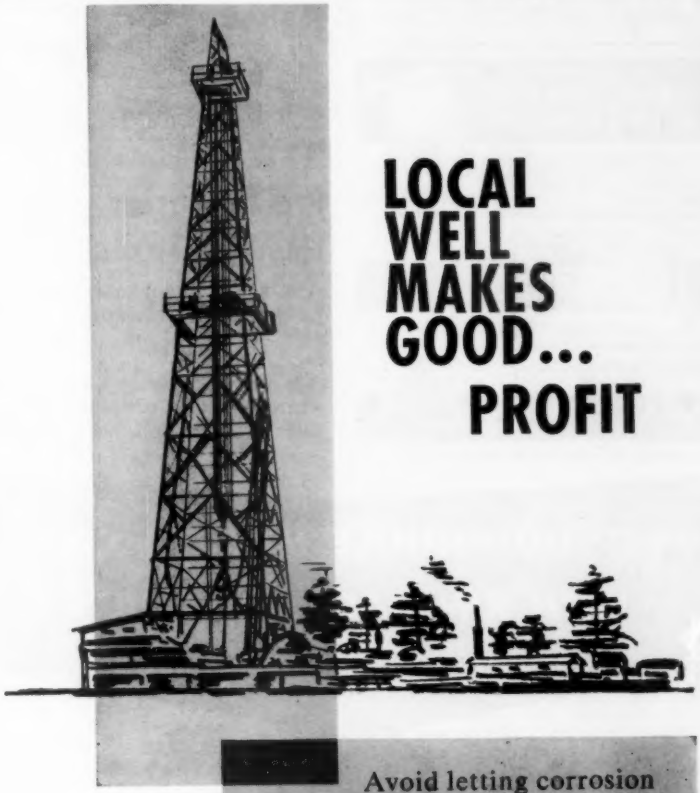
Rhine Petroleum Industries 1 Sargent, SE NE NW 16-32n-3e, Rio Arriba County, is contracted to 2,500 ft. as a Morrison test.

San Juan County drew the other tests, which were: Southern Union Gas Co. 1 Richardson Unit, NE NE 2-27n-13w; Benson - Montin Greer 2 Ginther in NE SW 13-27n-132, and El Paso Natural Gas Co. 27-20 San Juan Unit 30-5, in SW SW 20-30n-5w.

Flaxton field well makes heavy oil flow

A development well in Flaxton field, Burke County, North Dakota, has reported a flow rate of 54 bbl. an hour. The prolific producer offsets small pumping wells.

The flowing well is Simcox Oil Co.



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1-B Anderson, SE NW 29-163n-90w. On production test it gaged 652 bbl. of oil in 12 hours, flowing through 11/64-in. choke, from perforations in the Nesson pay at 5,775-83 ft. No. 1-B Anderson is in the southeastern portion of the field. Wells to the east and southeast were completed on the pump for 50 bbl. of oil a day from perforations in the Midale and Nesson zones.

Ohio wells completed

In Ohio, of the three wildcats completed last week, one was a gas discovery. The W. H. Patten 1 E. A. Robinson, Lot 26, Third Quarter, Monroe Township, Coshocton County, flowed 1,090 M.c.f.d. with rock pressure of 1,060 psi. Production was from Clinton sand sat 3,390-3,400, 3,411-24, 3,430-40 ft. Total depth is 3,458 ft.

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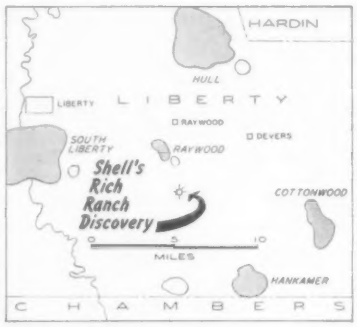

RICH RANCH discovery well in Texas coast's Liberty County makes high condensate yield.

Prolific gasser found in Texas

ANOTHER deep condensate-rich gas-productive area appears to have been uncovered in Texas' upper coastal district.

It is in southeastern Liberty County where Shell Oil Co.'s initial test on its Rich Ranch block is being completed with a daily flow rate through 12/64-in. choke of 857 bbl. of condensate and 2,900 M.c.f. of gas.

Discovery well, 1 Shell-Bill Daniel, is 3 miles south of Raywood, and 15 miles southeast of Liberty, county-seat. Nearest production is Raywood field, a multiple-pay oil and gas area, just south of town.

Production is from a Yegua sand at 11,085-11,127 ft. Raywood field is productive both from the Eocene-Cook Mountain and the shallower Vicksburg sands.

Shell had proposed to drill to 15,000 ft. but stopped at 13,964 ft. after drilling through the pay section. Location for its second test, 2 Shell-Daniel, on the block is 2,350 ft. northwest. Drilling already is under way.

The block on which these wells are located covers approximately 6,000 acres.

Texas failure produces

New oil was being swabbed in a West Texas Ellenburger failure. Ralph Lowe 1 A. M. Morgan estate, western Andrews County wildcat, recovered 15 bbl. of oil an hour plus 10% acid water from Devonian perforations at intervals between 8,731-8,802 ft.

The test had top of the Ellenburger at 11,424 ft., total depth at 11,490 ft., then plugged back to 9,007 ft. Location is 31 miles west of Andrews, in Section 11, Block A-50, PSL Survey. Block 12 field, 4 miles to the southeast, has Ellenburger, Devonian and Permian pays.

No. 1 Morgan had oil and gas shows on drill-stem tests of the Wichita Albany around 7,875-8,023 ft.

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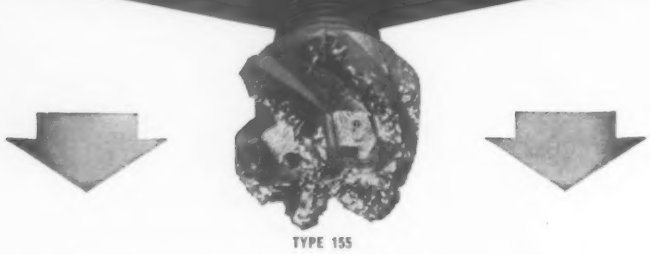

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Discovery wells

WESTERN CANADA

Alberta: Sohio-Sinclair 10-11-74-8w6 La Glace, LSD 10, 11-74-8w6. Triassic oil discovery. TD 7,957 ft.

Texaco 1-27-56-2 Frog Lake, LSD 1, 27-56-2w4. Blairmore oil well. TD 2,018 ft.

Sun 10-29-37-7 Consort, LSD 10, 29-37-7w4. Viking gas well. TD 3,381 ft.

Supertest White Rose 14-9-28-19 Drumheller, LSD 14, 9-29-19w4. Detrital oil discovery. TD 5,615 ft.

Mobil-Pan American 6-26-64-23 Waskahigan, LSD 6, 26-64-23w5. Dunvegan gas discovery. TD 11,541 ft.

Kewanee 7-29-27-16 Cessford, LSD 7, 29-27-16w4. Cessford gas discovery. TD 4,240 ft.

Western-Imperial 10-36-28-6 Wildcat Hills, LSD 10, 3-28-6w5. Mississippian gas discovery. TD 10,865 ft.

British-American-CPR-Gerald 9-17-34-25 Wimborne, LSD 9, 17-34-25w4. Mississippian gas discovery. TD 8,668 ft.

British Columbia: Fargo et al. 1A-h East Blueberry, 1-H-94-A-13. Mississippian gas discovery. TD 6,800 ft.

Saskatchewan: Cypress 10-32 Semple, LSD 10, 32-11-29w3. Medicine Hat gas well. TD 1,583 ft.

ARKANSAS

Franklin County: Gulf Oil Corp. 1 Dunn, 24-8n-28w, ½ mile southeast of Peterpender. IP 960 M.c.f.d., 40/64-in., shut-in TP 1,950 psi., perf. 7,606-32 ft., Hale sand. TD 7,755 ft. New gas field 2½ miles southwest of Aetna field. New field discovery.

CALIFORNIA

Sacramento County: Brazos Oil & Gas Co. 1 Locke Unit, SE NE 26-5n-4e, dual completion, upper perfs at 3,680-3,700 ft. made 1,035 M.c.f.d. through 11/64-in. choke; lower zone at 7,702-22 ft. and 7,776-86 ft. made 1,290 M.c.f.d. through 9/64-in. choke, TD 8,500 ft. (Two deeper pool discoveries in Walnut Grove Gas Field).

COLORADO

Morgan County: Strain Drilling Co. 1 Aschenbrenner, C NE SE 14-4n-60w. IPF 175 BOPD, "D" sand discovery, new field. TD 6,323 ft. "J" sand.

SOUTH LOUISIANA

Lafourche Parish: Hassie Hunt, Trustee, et al. 1-A Verdin-Parro et al. Unit 1, 64-15s-17e, 1¼ miles northwest of Rosseau field. IP 4,250 M.c.f.d., 47 BPCD, 54.1°, TP 7,800 psi., perf. 13,004-14 ft., and 2,100 M.c.f.d., 164 BOPD, 46.6°, TP 7,000 psi., perf. 13,316-22 ft. TD 15,170 ft. New-field discovery.

NEBRASKA

Banner County: Sinclair Oil & Gas Co. 1 Singleton Estate "B," C NW NE 31-17n-53w. IPP 314 BOPD, "J" sand discovery, new field. TD 5,800 ft "J" sand.

NEW MEXICO

Chaves County: British-American Oil Producing Co. 1 Honolulu, NW NE 27-14s-29e, 11 miles west Caprock field. IP 312 BOPD, 24/64-in. choke, 55.4°, GOR 307:1, Donovian 10,222-42 ft. TD 10,360 ft., elevation 3,826 ft.

Ross Brunner 1 Honolulu-State, 14-11s-27e, 18 miles east of Roswell. IPP 46 BOPD, Permian 947-1,002 ft. TD 1,052 ft.

J. C. Williamson 1 White Ranch, NE NE 1-12s-28e, 4 miles west of White Ranch field. IP 389 BOPD, 20/64-in. choke, 45.5°, GOR 250:1, TP 75 psi., Devonian 8,128-40 ft. TD 8,140 ft.

Texaco, Inc. 2 Perry-Federal, 29-15s-30e, ½ mile south extension to field discovery. IP 469 BOPD, 14/64 in. choke, 60°, GOR 1,910:1, Devonian 11,140-90 ft. IP 243 M.c.f.d. 20/64-in. choke, Ellenburger 12,070-12,122 ft. TD 12,313 ft., elevation 3,972 ft.

NORTHWEST NEW MEXICO

San Juan County: Redfern & Herd 1 Phillips, NE NW 16-28n-11w. IPF 3,066 M.c.f.d., Dakota discovery, new field. TD 6,245 ft. Dakota.

OKLAHOMA

Beaver County: Sun Oil Co. 1 C. Harper, 36-1n-24eCM. IP 88 BOPD, 44.1°, Tonkawa 5,990-98 ft. TD 6,100 ft. New field.

El Paso Natural Gas Co. 1 Oklahoma-Jackson, C NW NW 7-1n-26eCM. IPF 1,900 M.c.f.d., 32 BOPD, Cherokee 7,208-18 ft., 7,276-7,302 ft., 7,350-60 ft., 7,422-42 ft. TD 8,476 ft.

Kay County: Monsanto Chemical Co. 1 Whiteneck, NW NW SE 36-25n-1w. IPF 6,240 M.c.f.d., Layton 3,132-64 ft., Wilcox 4,356-78 ft. TD 4,700 ft.

Kingfisher County: King-Stevenson 1 Wells, C NW NW 27-18n-7w. IP 35 BOPD, 7,050-60 ft. TD 7,875 ft.

Jones & Pellow 1 Schimanek, C NE NE 16-19n-6w. IPF 176.7 BOPD, 39°, Mississippian lime 6,769-6,836 ft. TD 6,837 ft.

Major County: Sinclair Oil & Gas Co. 1 E. E. Spafford, NE SE SW 33-23n-16w. IPF 40 BOPD, 5,571 M.c.f.d., 50°, Hunton 8,271-8,358 ft. TD 9,400 ft.

Stephens County: Woods Petroleum Corp. 1 Coleman-Jamison Unit, C NW NE 14-2s-14w. IP 490 BOPD, McLish 7,601-11 ft., Oil Creek 7,872-75 ft. TD 8,070 ft. 40°.

EAST TEXAS

Houston County: Harris R. Fender 1 Houston County Timber Co., G. Gonzales Sur., A-463, 5 miles southwest of Kennard. IP 23 M.M.c.f.d., plus 25 BCPM, Woodbine 7,837-39 ft. TD 8,000 ft.

NORTH TEXAS

Foard County: Tennessee Gas Transmission Co. 1 A. A. Swank, Sec. 21, Blk. A. T&NO Sur., 13½ miles northwest of Crowell, 4½ miles northwest Raspberry field. IPP 110 BOPD, 42°, GOR 450:1, pay 4,854-59 ft. TD 6,972 ft.

Jack County: Bayview Oil Corp. and Exploration Surveys, Inc. 1 H. C. Gilmore. George Dedrick Sur., A-176, 3 miles south of Alco field. IP 375 BOPD, 16/64-in. choke, TP 720 psi., pay 4,588-4-611 ft. TD 4,659 ft., ground elevation 1,105 ft.

Young County: Gulf Oil Corp. 2 The Allar Co. "C," Sec. 3,410, TE&L Sur., A-1230, 7 miles southwest of Newcastle. IP 308 BOPD, 24/64-in. choke, TP 165-90 psi., 38°, GOR 281:1, perforated 3,288-98 ft. TD 3,344 ft.

Texaco, Inc. 2 M. A. Mays, Margaret Edmonds Sur., A-91, 17 miles southwest of Graham. IP 116 BOPD, 16/64-in. choke, TP 100 psi., 42°, GOR 450:1, perforated 4,421-25 ft. TD 4,447 ft.

Texaco, Inc. 1 S. B. Harbison, Margaret Edmonds Sur., A-91, 17 miles southwest of Graham. IPP 82 BOPD 43°, Mississippian 4,453-69 ft. TD 4,500 ft.

SOUTHWEST TEXAS

Dimmit County: Gulf Oil Corp. 1 Hugh Fitzsimmons et al., Juan Francisco Lombrano Grant, A-1360, 8.5 miles southwest of Dentonio. IPP 35 BOPD (net), 59% water, 43.5°, GOR 500 cu. ft. per barrel, perf. 5,334-5,416 ft., Austin Chalk. TD 10,648 ft. New-field discovery—Southwest Dentonio.

Duval County: Neville G. Penrose, Inc., 1 Ada B. Cantu, San Pedro de Charco Redondo Grant, A-475, 14 miles south of Benavides. IP 121 BOPD, ⅛-in., 43.2°, GOR 585 cu. ft. per barrel, TP 575 psi., perf. 5,341-45 ft., Jackson. TD 5,400 ft. New-field discovery.

Hidalgo County: Humble Oil & Refining Co. 3 Estate of W. K. Shepperd, San Salvadore Del Tule Grant, 8½ miles southeast of Linn. AOF 4,100 M.c.f.d., dry gas, shut-in TP 5,008 psi., perf., 9,308-30 ft. TD 10,000 ft. New reservoir in La Coma area.

Maverick County: Continental Oil Co. 566-1 N. J. Chittim, Sec. 566, John Foster Sur., A-102, 19 miles northeast of Eagle Pass. IPP 6 BOPD (net), 16% water, 28.5°, perf. 255-255½ ft., Navarro. TD 295 ft. New field—Chimeneas.

Starr County: Sun Oil Co. 3 J. L. Hinojosa, Share 3, Santa Cruz Grant, 28 miles northeast of Rio Grande City. IPP 156 BOPD, GOR 918 cu. ft. per barrel, perf. 6,192-96 ft. TD 6,300 ft. New pay in South Jay Simmons field.

EVER WONDER ??

GEOQUESTION . . .

Do gas wells produce "distillate" or "condensate"?

GEOANSWER . . .

Proper use dictates "condensate."

TEXAS GULF COAST

Goliad County: Skinner Corp. et al. 1 Philip Johnson Unit, Ramon Musquiz Grant, A-29, 1 mile southwest of Charco. AOF 7,500 M.c.f.d., GLR 22,440 cu. ft. per barrel, 57.6°, shut-in TP 1,766 psi., perf. 4,752-58 ft., Yegua. TD 7,775 ft. New-field discovery.

Hardin County: Henley Fuller Enterprises 1 Collins, M. M. De-Casanova Sur. A-11, 4 miles north of Votaw. IP 96.25 BOPD, ⅛-in., 37°, GOR 300 cu. ft. per barrel, TP 550 psi., perf. 5,414-16 ft. TD 5,672 ft. New-field discovery —West Menard Creek.

Jackson County: Edwin L. Cox, Turnbull & Zoch, and Union Oil Co. of California 1 Rose & Sample, Elizabeth McNutt Sur., A-46, 6 miles south of Edna. AOF 95 M.M.c.f.d., GLR 156 M.c.f. per barrel, 56.2°, shut-in TP 2,199 psi., perf. 5,783-85 ft., Frio. TD 7,000 ft. New-field discovery.

Lavaca County: North Central Oil Corp. 1 Alfreda Borchers Daniel, Robert Gordon Sur., A-200, 8 miles west of Morales. IP 24 BOPD (net), 55% water, 14/64-in., 34.8°, GOR 16,033 cu. ft. per barrel, TP 250 psi., perf. 8,649-80 ft., Wilcox. TD 9,600 ft. New-field discovery—Chicolete Creek.

WEST TEXAS

Crockett County: Cosden Petroleum Corp. 1 E. H. Hunt, Sec. 2, Blk. F, GC&SF, 9 miles southwest of Ozona. IP, shut-in gas discovery. Strawn pay 9,006 ft., final perforations 9,006-69, 9,117-37 ft. TD 10,005 ft., ground elevation 2,479 ft.

Monterey Oil Co. 23-40 Harris, Sec. 40, Blk. 1, GC&SF, 10 miles northeast of Iraan. IPP 117 BOPD, 31.6°, GOR 62:1, Clear Fork 3,960-4,020 ft. TD 8,060 ft., ground elevation 2,518 ft., top Ellenburger 7,770 ft.

Irion County: Mound Co. 1 O. J. Estes, Sec. 7, Blk. 17, H&TC Sur., 10 miles southwest of San Angelo. IPP 11 BOPD, 28°, GOR 125:1, Permian pay 818-830 ft. TD 900 ft.

Woodward, Turner & Webb 2 Brooks, Sec. 15, Blk. 3, H&TC Sur., 3.6 miles east of Mertzon. IP 231 BOPD, ¼-in. choke, 38°, GOR 800:1, TP 325 psi., Permian limestone 4,634-49 ft. TD 7,140 ft., ground elevation 2,312 ft.

McCulloch County: Low Drilling Co., Inc., and E. C. Johnston Co. 1 C. H. Miller, Sec. 1184, Bonn Sur., 4 miles northwest Fife. IP 3,100 M.c.f.d., pay 1,376-84 ft. TD 1,614 ft., elevation 1,421 ft.

Terry County: NE-O-Tex Corp. 1 Wilmeth, Sec. 44, Blk. K. PSL Sur., 4 miles south of Tokio. IPP 85 BOPD, 36°, GOR 365:1, Clear Fork 8,084-8,111 ft., TD 13,440 ft., elevation 3,473 ft.

WYOMING

Crook County: True Oil Co. 1 Walter Thompson, NW NE SW 5-49n-65w. IPP 23 BOPD, Lakota discovery, new field. TD 454 ft. Lakota.

SEG's Hall—Optimistic Explorer

- New president of geophysicists is convinced there's still plenty of opportunity for the world's oil hunters.

IT TAKES optimism to find oil.

Not just happy-go-lucky optimism. But optimism with vision and cautious, but confident, aggressiveness.

"I'm opposed to the pessimists who spill loose talk about the end of the road for this profession, for that type of oil field skill, for the oil hunting group generally."

Speaking is Tom O. Hall, just elected president of the Society of Exploration Geophysicists. He takes over as lead man for 5,660 members of the far-flung SEG in November. He has specific ideas of what has made, and will continue to make the oil business tick.

No illusions does he harbor about turning the oil world upside down and revolutionizing things during his regime. Rather, he has a zealous hankering to nullify the gospel of the doubters, which he thinks has been permitted to flow too long with only token challenges.

"Wish I were more articulate," he tells friends.

"I may not get over what I'm thinking, but I know how I feel." There's no doubt in the minds of those who hear him. He exudes sincerity.

Balanced view . . . Hall has had a varied view of the industry to help him appraise its success and its lower ebbs.

In 30 years he has tramped swamps and plains and mountains with torsion balance and seismic crews. Too, he has scanned the oil business from an academic plane. He taught mathematics and did graduate work at Southern Methodist University in earlier years.

He knows the "before" attitudes of the student and the college professor. And he knows the "after" picture from a quarter century of brushing with oil people worldwide.

"No one need be pessimistic about the future of our sciences," he says.

"Right now, it is true we've got to push research and development efforts to find newer and better ways of doing things. But basically, the fundamental benefits of our profession and what it can and will contribute to oil and other industries are far, far from being exhausted.

"The picture may not be too bright just at present, but it can change overnight. It has done it before and will again."

Hall knows. He was barely out of the classroom and getting his feet wet with a seismograph party when the depression of the early thirties swept him into ranks of the unemployed.

He was graduated from Southern Methodist University, Dallas, in 1927 with a B.S. degree in mathematics and physics. Immediately he was tabbed by the late Dr. Robert S. Hyer, president emeritus of SMU, to do field research work in South and West Texas on an electrical prospecting project.

In 1930 he joined Roxanna Petroleum Corp. as assistant party chief on a torsion balance crew. And in the summer of 1931 he and his crew were looking for jobs. The bottom had fallen from business generally.

He returned to SMU as instructor in mathematics in the engineering department, doing graduate work in physics on the side. He rode out the depression there, rejoined Shell Oil Co., then successor to Roxanna, in 1933 as seismologist working in Louisiana, Texas and New Mexico.

▶▶▶ Personals

Dr. Lloyd Snyder has been named senior research chemist in Union Oil Co.'s Brea, Calif., research center.

Bernard J. Clarke, chief supervisory engineer for Columbia Gas System Service Corp., has been elected a vice president. He will be in charge of engineering and research for the system. Clarke joined Columbia Gas System in 1952.

Richard S. Barfield, project manager for Pipe Line Technologists, Inc., Houston, has been named manager of European operations of the company. He will headquarter in The Hague. Barfield was with Gulf Refining Co. before joining Pipe Line Technologists in 1957.

Dr. William C. Hamilton has been promoted to supervising research chemist in the analytical section by Continental Oil Co.

David Anderson has been named product superintendent of petrochemicals for Polymer Corp., Ltd., Sarnia, Ont.

Dr. R. W. Walker has been named director of the research division of Sinclair Research Laboratories, Inc. He succeeds **Dr. R. R. Chambers,** who was recently named technical manager. Walker, a graduate of Ohio Wesleyan and Ohio State universities, joined Sinclair in 1953.

In 1938 he was employed as a party chief by General Geophysical Co. of Houston and in 15 busy years rose to the company's presidency.

First SEG office . . . The new SEG head man has been a member of the organization 18 years. He never has quit selling those in the oil industry and others on the role of science and technology in petroleum's relentless search for reserves.

He's never before been an officer of SEG but he has had many platforms from which to tell the geophysical and scientific story.

Hall's a member of the European Association of Exploration Geophysicists, has served as president of the Geophysical Society of Houston, is a member of the Houston Geological Society, the AAGP, the Houston Club and the Petroleum Club of Houston.

It was while he was party chief at Lake Charles, La. in 1935 that he met and married Mrs. Hall. A son, Tom Jr., 21, is a senior engineering student at SMU and Ann, 11, is in the fifth grade.

Challenge remains . . . "There is just as much opportunity for satisfying goals and success in geophysical work today as there ever has been," he insists.

"The same old truths about initiative and creativeness and sticking to fundamentals paying off holds good today. We've got a lot of preaching to do, but it's a true and heartening story and it's our job to spread it."

That, Tom Hall will do. From Houston on November 9, when he formally becomes president, he will take off on a year's round of official visits to 24 SEG chapters in the United States, Canada, and South America. He also will make at least one official apearance before European geophysicists in 1960.

His tactful missionary theme will be: No matter how good the present or the past, they don't hold a candle to the technical possibilities of the future in the petroleum field.

W. A. Clough, formerly vice president and exploration manager of Anschutz Drilling Co., Inc., has joined Anderson-Prichard Oil Corp. in Denver as senior geologist.

Allan J. Brunett, junior production engineer for Sunray Mid-Continent Oil Co., has been promoted to production engineer in Oklahoma City. **George C. Kite,** junior production engineer, has been named production engineer in Midland, Tex.

Lloyd Madsen has been named manager of Rocky Mountain Oil and Gas Association's new western division in Salt Lake City.

Merle S. Keffer, formerly with Coastal Crude Oil Co., has joined the crude-oil purchases and sales department of Cactus Petroleum, Inc. He will headquarter in Houston.

N. C. Turner, formerly vice president of Hudson Engineering Corp., has joined Transwestern Pipeline Co. as vice president in charge of engineering and operations. A graduate of Ohio State University, Turner was with Hudson Engineering 12 years. He was chief engineer of Jones & Laughlin Steel Corp.'s engineering and construction division before that time.

G. W. Miller, head of the economics and budget group in chemical technical service at Esso Standard Oil Co.'s Baton Rouge refinery, has been named head of the lubricants and specialties economics group in process engineering. **M. A. Noble,** head of the design group in chemical technical service, will succeed Miller. Noble will be succeeded by **F. W. Rogers,** head of the refining group in petroleum technical service. **W. G. Veltrop,** head of the cracking group, petroleum technical service, succeeds Rogers; and **E. C. Foley,** engineer in the process engineering department, succeeds Veltrop.

B. C. Shaul, superintendent of engineering, maintenance, and construction at Tidewater Oil Co.'s Avon refinery at Associated, Calif., has been appointed general superintendent. **C. L. Persyn,** superintendent, cracking, has been named operating superintendent. Shaul will be in charge of engineering, maintenance, construction, employe relations, accounting, technology, and control laboratories. Persyn will be in charge of all process facilities, shipping, and utilities at the refinery. Also, **E. F. Courtney,** superintendent of shipping and utilities, has been named superintendent, petrochemicals. All are new posts at Avon. In other appointments, **H. L. Benson,** superintendent of distillation, reforming, and treating, will succeed Shaul as superintendent of engineering, maintenance, and construction. **S. A. Bordi** will succeed Benson. **P. B. Williamson** will succeed Persyn as superintendent of cracking, and **C. C. Carmine** will succeed Courtney as shipping and utilities superintendent. **R. N. Johnson,** chief technologist, has been named staff assistant to the division manufacturing manager.

▶▶▶ Personals

Lloyd Waner, Sunray Mid-Continent Oil Co. geologist, has been transferred to Casper, Wyo., from Tulsa.

Carl M. Houser, district engineer with Amerada Petroleum Corp., has been transferred to Charlson, N. D., from Seminole, Tex.

Don Jerome, formerly exploration superintendent in Fort Worth for Sinclair Oil & Gas Co., has been named executive secretary of the new Arizona Oil & Gas Commission in Phoenix. Jerome was a vice president of Sinclair Canada Oil Co. in Calgary before moving to Fort Worth.

F. C. W. Paton, Gulf Oil Corp.'s vice president, marketing, Western Hemisphere, extraterritorial, will move to Fort Lauderdale, Fla., from Pittsburgh next month in a change of operating headquarters for his department. Others moving to Fort Lauderdale include **J. T. Van Tuyle,** coordinator of operations, and **Donald G. Mavor,** coordinator of sales.

Jerome J. Wright, formerly exploration superintendent and chief geologist with Coronet Oil Co., has opened consulting geological offices in Midland, Tex. Wright was with The California Co. in the Rocky Mountain, Mid-Continent, and Gulf areas before joining Coronet.

Howard Parker, foreman at Cities Service Gas Co.'s Greensburg, Kans., station, has been promoted to superintendent of the company's Tonganoxie, Kans., station. He succeeds **W. L. Mallams,** who has been transferred to Welda, Kans., **C. D. Campbell,** formerly Welda superintendent, has moved to the Hazelton, Kans. station. **Joe Barker,** superintendent at Hazelton, has been transferred to Guymon, Okla. **Jewell Pace,** formerly at Guymon, has been transferred to Pierce City, Mo., where he will succeed **George Crane** as superintendent. Crane recently retired. In other changes, **Melvin Frack,** formerly in Hazelton, has been promoted to foreman at the Mooreland, Okla., station. **C. H. Starns,** Mooreland, has moved to Hazelton as foreman. **A. R. Blanchard,** formerly foreman in Hazelton, has been transferred to Greensburg.

Personals

William L. Robbins, formerly senior petroleum engineer for Carter Oil Co. in Seminole, Okla., has been transferred to Creole Petroleum Corp. He will be senior engineer in the Tia Juana district on Lake Maracaibo for Creole.

R. P. Black, tool pusher with Penrod Drilling Co., has been transferred to Houma, La., from New Town, N. D.

Paul D. Sweitzer, drilling foreman for Texaco, Inc., has been transferred to Wichita Falls, Tex., from Abilene, Tex.

Frank F. Axtell, construction engineer with Texaco, Inc., in Port Arthur, Tex., has been transferred to Houston on special assignment.

Laurel G. Parkinson, Amoco Chemicals Corp.'s new general manager of marketing, has been elected a director of the company. Parkinson joined Amoco last year as general sales manager, chemicals.

Wayne Davison, veteran geologist in the Rocky Mountain, Mid-Continent, and Gulf Coast areas, has opened consulting offices in Anchorage, Alaska. He was formerly in Tulsa.

Eugene J. McNeely, executive vice president of American Telephone & Telegraph Co., New York, has been elected a director of Continental Oil Co. McNeely, who is also a director and member of the executive committee of AT&T, has been with the Bell system since 1922.

Philip F. Nind, general manager of Shell Petroleum Co. affiliates in Lebanon, Syria, and Cyprus, will be transferred to Shell in London October 1. **C. D. Van Lennep** of Royal Dutch Petroleum Co. will succeed Nind in Beirut.

William H. Harpster, Tampa, Fla., district sales manager for Sun Oil Co., has been named manager of the Long Island sales district. He succeeds **Louis J. Ford,** who was recently named wholesale department manager in Sun's New York sales region. **Robert E. Dyer,** sales manager of the Exeter, Pa., district, will succeed Harpster in Tampa.

O. DeVere Wootten, formerly consulting counsel with Big Piney Oil & Gas Co., Salt Lake City, has been named general manager of the company.

James B. Spradling has joined the research department at Monsanto Chemical Co.'s plastics division in Texas City. **Doyle R. Wise** has joined the manufacturing department there.

George S. Garbarini, geologist with Sun Oil Co., has been transferred to Durango, Colo., from Bismarck, N. D. **D. H. McFadden** will succeed Garbarini in Bismarck.

Leonard Simmering, district production superintendent in Elkhart, Kans., for Panhandle Eastern Pipe Line Co., has joined British-American Oil Producing Co. as production engineer in Sterling, Colo.

Dean Hadfield, assistant manager of marketing in Continental Oil Co.'s southwestern region, Fort Worth, has moved up to regional marketing manager. He succeeds the late B. T. Willey.

John W. Gendron, formerly assistant general manager of Tidewater Oil Co.'s eastern division, has joined Richfield Oil Corp. as general manager of transportation and supply. He will be in charge of the supply and distribution, marine, and pipeline departments. Gendron was assistant to the president of Tidewater before his appointment as assistant eastern division manager.

J. L. Olvey, assistant refinery manager for Frontier Refining Co., has been elected assistant vice president. In other appointments, **Donald E. Arnell,** assistant to the executive vice president, has been named assistant vice president for administration. **Roy H. Jordan** has been named assistant treasurer and will continue as manager of the company's credit department.

William John McPherson and **John Darrow Hale** have formed McPherson-Hale Consultants, Ltd., in Calgary. The consulting firm will specialize in reserves and exploratory evaluation. Hale was exploration manager for Canadian Seaboard Oil Co. at one time and has been with Texas Exploration Co., Calgary, since the Texaco-Seaboard merger. McPherson has been with Imperial Oil, Ltd., Calvan Consolidated Oil & Gas Co., Ltd., Westcoast Transmission Co., and Pacific Petroleums, Ltd.

Tom Ross, Sinclair Oil & Gas Co. geologist, has been transferred to Houston from Casper, Wyo.

D. W. Bolyard, junior geologist with Sunray Mid-Continent Oil Co., has been promoted to geologist in Casper, Wyo.

Wilbur Johnson, tool pusher with Falcon Seaboard Drilling Co., has been transferred to Guymon, Okla., from Laverne, Okla.

C. M. Chappell, formerly geophysicist with Shell Oil Co., has opened consulting offices in Denver. He will specialize in geological-geophysical integration problems.

Marshall Farrier, formerly analyst in Continental Oil Co.'s coordinating and planning department, Houston, has been transferred to Oklahoma City as assistant to the regional management there.

Clarence (Ted) Shaw, Jr., formerly with Kerr-McKee Oil Industries, Inc., has joined Monsanto Chemical Co.'s Lion Oil division as assistant manager of gasoline and fuel oil sales.

Arthur J. Wessely, formerly vice president of H. J. Gruy & Associates, Inc., has joined Global Oils, Inc., Dallas, as vice president and director of exploration. A graduate of the University of Texas, Wessely had been with Gruy & Associates for two years. He was with Sun Oil Co. and Core Laboratories, Inc., before that time.

Walter Kilgo, formerly assistant to the division petroleum engineer for Standard Oil Co. of Texas, has joined Vickers Petroleum Co., Inc., as district production superintendent. He will be in charge of production activity in Oklahoma, Texas, and New Mexico with headquarters in the new Perryton, Tex., office which the company plans to open.

Charles N. Kimberlin, Jr., assistant director of Esso Research & Engineering Co.'s Baton Rouge, La., laboratories, has received his 100th patent. Kimberlin was 1957 winner of American Chemical Society's Southern Chemist Award. He joined Esso in 1933 and has been assistant director at Baton Rouge since 1954. He is the first Esso Baton Rouge employe to hold 100 patents.

FOX

James E. Fox, Jr., drilling research engineer in Fort Worth for Pan American Petroleum Corp., has been named division drilling superintendent there. He succeeds **James L. Nichols,** who recently retired. Fox joined Pan Am in 1945 as junior engineer in Hobbs, N. M. He had been drilling research engineer in Fort Worth since 1954. He is a graduate of the University of Oklahoma.

A. C. Saul, Shell Oil Co.'s manager of West Coast operations in transportation and supplies, will move to Los Angeles from San Francisco near the end of the year in a consolidation of area transportation and supplies activities in Los Angeles. **W. H. Adams,** manager of traffic in San Francisco, and **L. J. Clisham,** manager of crude-oil and products supply in Los Angeles, will retire December 31. **E. J. Dunne,** assistant manager of traffic in San Francisco, will succeed Adams. **R. J. Sullivan,** an assistant manager in Shell's New York traffic office, will succeed Dunne.

Name of the Bureau of Mines' Petroleum Experiment Station in Bartlesville, Okla., has been changed to Petroleum Research Center and **Harry C. Fowler,** formerly superintendent of the station, has been named first research director. **K. J. Hughes** has been named superintendent of the center and will take charge of administrative duties. Also, the Bureau of Mines has set up a new division of mineral resources in Bartlesville. **D. B. Taliaferro,** formerly chief of the production branch and assistant superintendent at the Bartlesville station, will head the new division. Research work at the center will be directed by 6 project coordinators. They are **C. C. Ward,** chemistry and refining; **J. P. McCullough,** thermodynamics; **C. K. Eilerts,** petroleum reservoir fluids; **H. N. Dunning,** surface chemistry and natural gas engineering; and **J. W. Watkins,** applied field engineering. **K. F. Anderson,** project coordinator in Dallas, will continue to head field engineering studies in Dallas and Wichita Falls, Tex. Fowler joined the Bureau of Mines in 1923 in Bartlesville as petroleum engineer. Hughes joined the station in 1943 as chemical engineer and research chemist, and Taliaferro has been in Bartlesville since 1928 when he joined the station as chemical engineer.

H. E. McBrayer, assistant head of petroleum technical service at Esso Standard Oil Co.'s Baton Rouge refinery, has been named assistant general foreman in the oil movement department. He succeeds **J. W. Rector,** who has taken over McBrayer's job in petroleum technical service. Also at Baton Rouge, **C. R. Wick,** process engineering, has been transferred to the lubricants and wax department, as a division foreman.

McVea Graham, head of the chemical products section in the crude and product coordination department at Esso Standard Oil Co.'s Baton Rouge refinery, has been named assistant head of the process engineering department. He succeeds **W. G. Reymond,** who was recently named head of the mechanical engineering department at Baton Rouge. **R. W. MacDonald,** formerly on assignment in Esso's New York office, succeeds Graham. **W. N. Kestner,** formerly senior technologist in process engineering, has been named assistant head of chemical technical service department. He succeeds **R. H. McCollister,** who recently moved up to head of the department.

C. A. Dunlop has retired after 35 years with Humble Oil & Refining Co. Dunlop has been active in development of specifications and industry standardization of oil-field materials through Humble and as a member of API committees. He is chairman of the API's committee on standardization of tubular goods and served for 15 years as chairman of the committee on rigs and derricks. He received a certificate of appreciation from API in 1951 in recognition of his standardization work.

▶▶▶ Deaths

James A. Doctor, 48, marketing vice president of Vickers Petroleum Co., Inc., was struck by a car and killed August 19 while he was changing a tire on a highway near Augusta, Kans. Doctor entered the oil industry in 1933 with Continental Oil Co. He was marketing vice president for Champlin Oil & Refining Co. before joining Vickers.

Richardson Pratt, 65, senior partner in Charles Pratt & Co., New York investment firm, and former assistant treasurer of Standard Oil Co. (N. J.), died August 16 in his Glen Cove, N. Y., home.

George B. Cree, president of Cree Oil, Inc., Pampa, Tex., died August 14 in Pampa after an illness of several months. Cree was a past vice president of Independent Petroleum Association of America.

Gerald G. Orr, 59, Houston drilling contractor, died August 12 after suffering a heart attack. Orr had been in semiretirement for several years. He was formerly part-owner of Edwards Drilling Co., Houston.

Rose Modrall, retired deputy supervisor in charge of the Rule 37 department for the Texas Railroad Commission, died recently. Miss Modrall joined the Railroad Commission in 1920 and retired in 1954.

Frank M. Head, 75, head of the Carter County, Oklahoma, Producers Association since 1949 and former vice president of Wirt Franklin Petroleum Corp., died August 14 in an Ardmore, Okla., hospital.

Albert S. Johnston, 76, president and owner of A. S. Johnston Drilling Corp., died August 15 at his home in Long Beach after a lengthy illness. Johnston started his oil career in the early 1900's in the fields around Spindletop. He later moved to California where he was active in development of San Joaquin Valley fields and at Signal Hill in the Los Angeles Basin.

John B. Wallis, 56, secretary and personnel administrator of Pacific Lighting Gas Supply Co., died August 12 in a Los Angeles hospital after brain surgery.

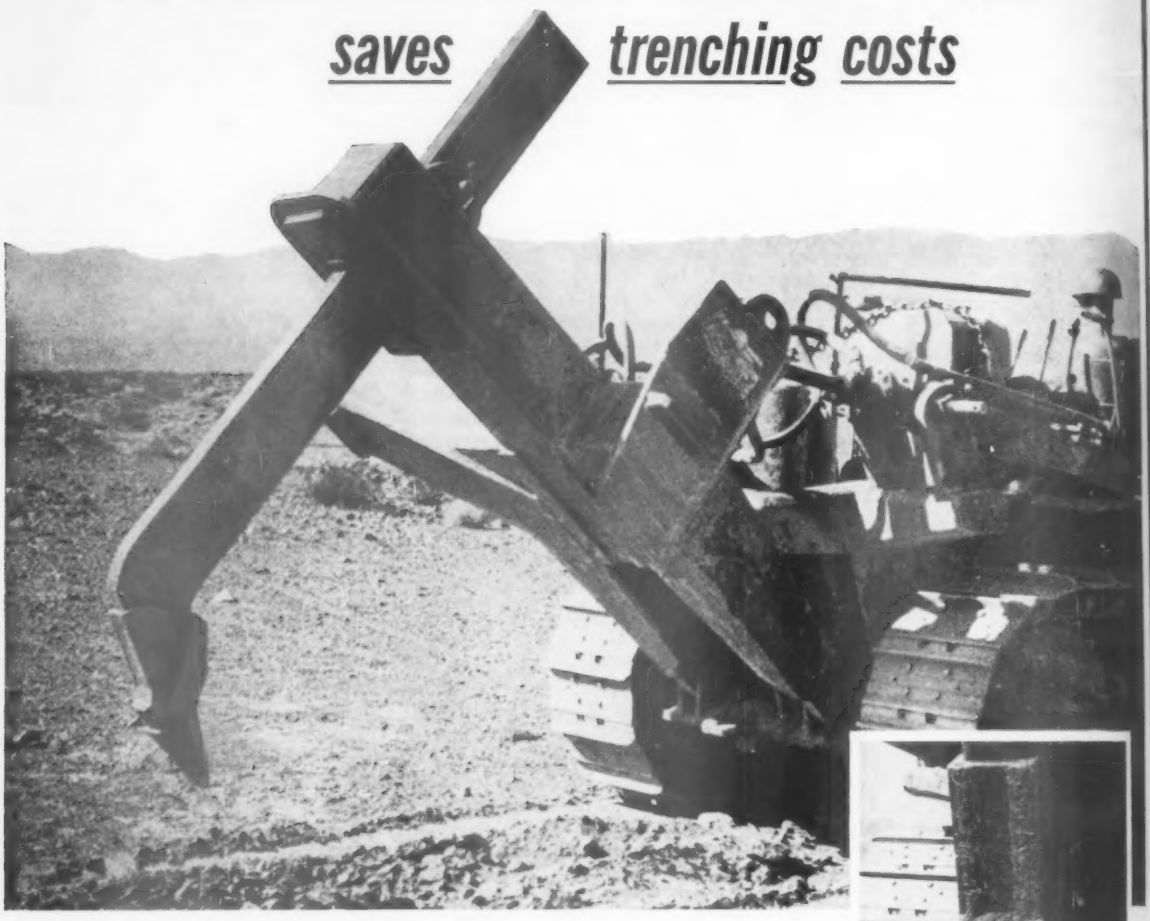
Joseph M. Tindall, 77, retired traffic manager of the old Stanolind Oil & Gas Co., died August 14 at his home in Tulsa. Tindall joined Stanolind in 1920. He retired in 1953.

Harlan Park, 52, Owensboro, Ky., producer, died August 7. Park had been in the oil business since 1928 and was active in the Tri-State area.

Eugene Herbert Eastland, 52, engineer with Standard Oil Co. of California, died August 12 in a Bakersfield, Calif., hospital.

Paul E. Sanders, 68, assistant manager for General Petroleum Corp., died August 11 in a Los Angeles hospital.

Subsurface Exploration with Giant Ripper *saves* *trenching costs*



Upper photo shows method of hard-facing back side of point and adapter. Lower photo illustrates front faces and sides.

STOODY HARD-FACING INCREASES WEAR LIFE 1200%

Crossing the heart of one of California's deserts is an 86 mile stretch of 34" gas line. This area was once riddled with lava flows and eventually overlaid with hard-packed sand. Large ditchers were stopped by the lava beds; explosives could not be economically used until location of each lava flow was determined.

To overcome these difficulties, the contractor designed and built a giant single-tooth ripper. Pulled by a D7 Tractor along the pipe line route at a depth of 5 feet, subsurface conditions were quickly determined. Areas free of lava were then trenched with conventional equipment. Where lava flows were discovered by the ripper, wagon drills prepared the beds for explosives.

The ripper used easily replaceable boot-type points and adapters of mild steel plate. On this job they lasted just two hours. The boots and adapters were subsequently manually hard-faced with cross beads of Coated Tube Stoodite—*stayed in service thereafter for 3 full 8-hour days!*

Stoody Alloys are made in many variations for all wear conditions on all types of equipment... electrodes and rods for manual application with electric arc and acetylene torch—or in continuous wires for semi-automatic and fully automatic welding. For dozens of ways to save money and downtime in your earth-working operations with Stoody hard-facing alloys, ask for free Stoody Guidebook. It's available from any Stoody Dealer (check the Yellow Pages of your phone directory) or write direct.

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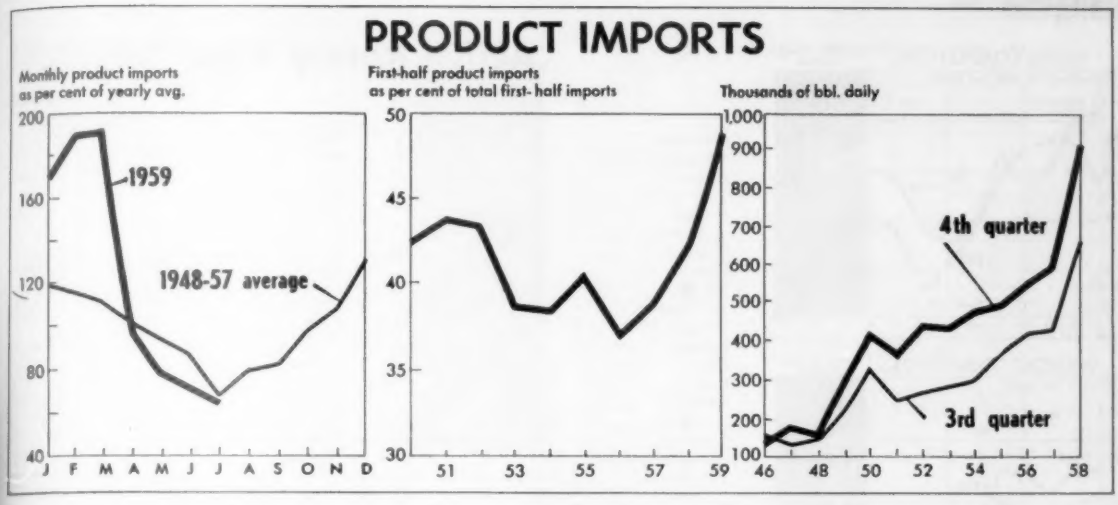

PRODUCT IMPORTS
Monthly product imports as per cent of yearly avg.
1959
1948-57 average
J F M A M J J A S O N D
First-half product imports as per cent of total first-half imports
51 53 55 57 59
Thousands of bbl. daily
4th quarter
3rd quarter
46 48 50 52 54 56 58

Product imports assume less erratic course

BY JOHN H. HYDEN
District Editor

PRODUCT IMPORTS for the first 7 months of 1959, expressed in the graph as per cent of yearly average, at first glance appear to represent a sizable increase in seasonal variation. But this year's pronounced fluctuations are a result of the combination of normal seasonal variations, and the reaction to 1958's voluntary crude-import quota and 1959's second-quarter mandatory import quota including product imports.

The regular first-quarter product-import peak was exaggerated in 1959 by an increase accompanying the crude-import restrictions. The March figure was 191% of the estimated daily average for 1959 compared to the average figure of 111%.

In April there was a product import drop of 640,000 bbl. daily from the March average of 1,310,000 bbl. daily to 670,000 bbl. daily. This decrease followed the installation of the mandatory import quotas and brought the relative position of April product imports down below a 1948-1957 average relative position, and below the estimated 1959 yearly average of 685,000 bbl. daily.

May and June product imports, in relation to the yearly average, continued to fall further below the 1948-1957 average, with the June figure of 72% being considerably below the 1948-1957 average for June of 88%. There was a continued drop in July but it was not as sharp a drop as the average July decrease for the 1948-1957 period. The relative position of July 1959 was 66% compared to the 1948-1957 relative position of 69%.

Two of the factors responsible for the comparative leveling off in July 1959 were (1) the revision of import quotas effective July 1, 1959, allowing a slight increase in product imports, and (2) the importing of products by some companies during the slack period. Importing in this period provides the advantage of the prevalent low tanker rates and assures an immediate supply for the increased winter demand.

This leveling off will also show up in a comparison of third-quarter and fourth-quarter product imports. Fourth-quarter product imports exceed third-quarter figures and have been increasing the difference since 1948. This difference will continue to exist but there will be a tendency to narrow the gap.

First-half product imports, as per cent of total first-half imports, have been increasing during the last 3 years after a decline in the 1951-1956 period. A new high of 49.1% was reached for the first 6 months of this year even though April, May, and June were put under the new quota.

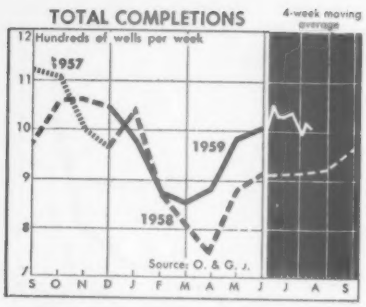
Residual imports for the first half of 1959 averaged 697,000 bbl. daily. This was a 34% increase over residual imports of 521,000 bbl. daily for the same period in 1958.

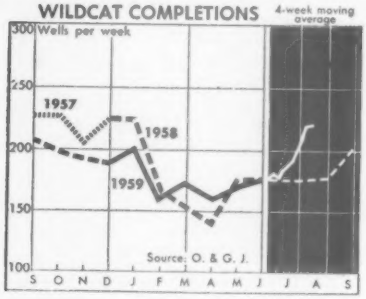
Imports of distillate for the first half of 1959 increased 93% over the first half of 1958, bringing the average to 56,000 bbl. daily. This increase followed a 1958 gain of 38% over 1957.

Gasoline imports for the January-June period this year averaged 34,000 bbl. daily compared to 23,000 bbl. daily in the first 6 months of 1958. This was a 48% gain over the 1958 figure. The voluntary crude quotas in 1958 brought about an increase in gasoline imports from 4,000 bbl. daily in the first 6 months of 1957 to 23,000 bbl. daily for the same period in 1958.

A quick look at the highlights . . .

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	6,813,150	UP	21,190	DOWN	20,275
Crude stocks	261,462,000	DOWN	2,230,000	UP	11,666
Completions	946	DOWN	46	DOWN	40
Refinery runs	7,950,000	UP	114,000	UP	237,000
Gasoline stocks	183,104,000	DOWN	377,000	UP	6,617,000
Kerosine stocks	29,473,000	UP	469,000	UP	2,455,000
Distillate stocks	147,907,000	UP	4,913,000	UP	20,140,000
Residual stocks	55,525,000	DOWN	850,000	DOWN	10,790,000
Four-product stocks	416,009,000	UP	4,155,000	UP	17,572,000
Total imports	1,362,300	UP	215,100	DOWN	31,600





Active Rotary Rigs

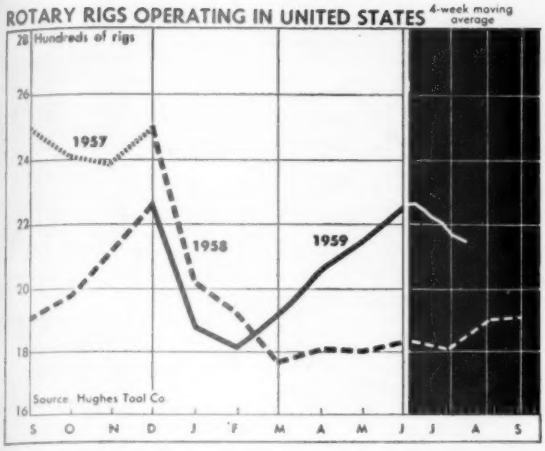
	8-17-59	8-10-59	8-18-58
Alabama	9	10	6
Arkansas	12	14	23
Arizona	7	1	2
California	84	93	74
Land	82	90	(*)
Offshore	2	3	(*)
Colorado	54	64	42
Florida	2	1	1
Land	1	0	1
Offshore	1	1	0
Illinois	33	39	47
Indiana	6	6	8
Iowa	2	2	3
Kansas	139	134	149
Kentucky	13	9	4
Louisiana	336	351	302
North	44	47	42
S. Inland waters	128	137	(†)
S. Land	109	115	223
Offshore	55	52	37
Maryland	0	0	0
Michigan	30	28	10
Mississippi	74	70	44
Missouri	1	1	0
Montana	28	31	24
Nebraska	32	22	25
Nevada	1	1	0
New Mexico	119	111	104
New York	1	1	1
North Dakota	24	27	30
Ohio	4	4	0
Oklahoma	220	230	207
Oregon	0	0	0
Pennsylvania	10	10	11
South Dakota	7	5	3
Texas	782	772	684
S. Inland waters	8	8	(†)
S. Land	214	206	134
Offshore	2	2	1
North-East	156	149	(*)
West Central	268	258	(*)
West	134	149	(*)
Utah	37	35	32
Washington	2	2	1
West Virginia	10	10	5
Wyoming	73	76	68
Total U. S.	**2,146**	2,160	1,910
Western Canada	155	158	142
Eastern Canada	0	0	2
Grand total	2,301	2,318	2,054

Hughes Tool Co. report. *Comparisons not available due to change in method of reporting. †Included in South-Land.

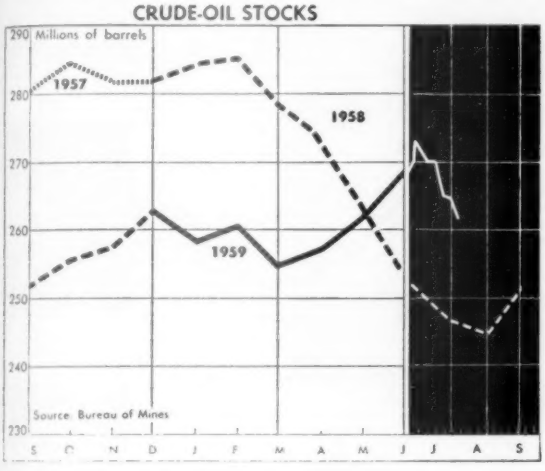
WEEKLY WELL COMPLETIONS . . . WEEK ENDED AUGUST 15, 1959

	Total wells							Cum.		Total wildcats					Cum.	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1959	1958	Total	Crude	Cond.	Gas	Dry	1959	1958
Alabama	1	0	0	0	1	0	7,131	60	45	1	0	0	0	1	16	17
Arkansas	19	7	0	3	9	0	87,761	523	446	3	0	0	1	2	91	105
California	28	18	0	2	8	0	148,204	939	1,033	6	0	0	1	5	230	235
Colorado	19	3	0	1	14	1	100,235	472	498	14	2	0	0	12	282	286
Illinois	45	28	0	0	17	0	97,937	1,354	1,312	6	0	0	0	6	220	256
Indiana	21	4	0	0	17	0	35,034	502	450	6	1	0	0	5	164	169
Kansas	92	44	0	4	44	0	340,060	2,486	2,331	28	6	0	2	20	589	492
Kentucky	21	10	0	0	11	0	30,758	1,530	674	5	3	0	0	2	132	75
Louisiana	65	33	6	8	18	0	494,472	2,240	2,104	6	0	0	0	6	295	303
North	28	12	0	7	9	0	100,528	828	744	4	0	0	0	4	120	115
South	33	19	6	1	7	0	340,745	1,174	1,082	1	0	0	0	1	163	170
Offshore	4	2	0	0	2	0	53,199	238	278	1	0	0	0	1	12	18
Michigan	15	8	0	0	7	0	53,486	384	263	6	0	0	0	6	96	89
Mississippi	11	11	0	0	0	0	110,183	386	241	0	0	0	0	0	173	115
Montana	5	2	0	1	2	0	34,259	196	203	1	0	0	0	1	61	88
Nebraska	24	10	0	0	14	0	149,429	541	433	11	2	0	0	9	232	205
New Mexico	49	28	0	7	14	0	200,641	1,250	1,236	7	1	0	0	6	150	160
West	25	15	0	6	4	0	93,472	572	597	0	0	0	0	0	43	69
East	24	13	0	1	10	0	107,169	678	639	7	1	0	0	6	107	92
New York	3	0	0	0	3	0	9,115	172	355	3	0	0	0	3	16	32
North Dakota	5	2	0	0	3	0	21,998	313	279	0	0	0	0	0	61	92
Ohio	29	5	0	15	9	0	79,392	602	663	2	0	0	0	2	17	8
Oklahoma	85	35	2	9	39	0	374,898	3,595	3,979	25	2	0	3	20	539	557
Pennsylvania	0	0	0	0	0	0	0	335	360	0	0	0	0	0	9	9
Texas	371	219	7	13	129	3	1,480,555	11,871	11,223	70	3	0	0	67	2,214	2,277
Dist. 1	16	5	0	2	9	0	57,281	692	616	8	0	0	0	8	197	247
Dist. 2	14	1	0	1	12	0	90,051	500	475	7	0	0	0	7	148	124
Dist. 3	32	14	4	1	12	1	148,234	749	807	1	0	0	0	1	148	177
Dist. 4	21	6	0	2	13	0	91,237	821	751	7	0	0	0	7	200	218
East	18	14	0	0	4	0	83,005	740	759	3	0	0	0	3	143	213
Dist. 7-B	56	34	1	0	21	0	129,844	1,626	1,511	11	3	0	0	8	423	424
West	125	95	2	1	27	0	675,556	3,681	3,266	18	0	0	0	18	508	452
Dist. 9	67	37	0	0	28	2	122,770	2,231	2,266	14	0	0	0	14	379	360
Dist. 10	22	13	0	6	3	0	82,577	831	772	1	0	0	0	1	68	62
Utah	4	3	0	0	1	0	23,411	200	256	1	0	0	0	1	54	54
West Virginia	14	0	0	9	5	0	30,958	470	440	0	0	0	0	0	15	12
Wyoming	19	4	0	5	10	0	86,836	593	457	8	1	0	0	7	200	128
Misc. (S. D.)	1	1	0	0	0	0	8,636	78	62	0	0	0	0	0	45	54
Total U. S.	**946**	475	15	77	375	4	4,005,389	31,092	29,343	**209**	21	0	7	181	5,901	5,818
Previous week	992	473	31	75	396	17	4,526,681			215	15	2	6	192		
Cum. 1959	31,092	15,724	762	2,261	11,533	812	128,896,777			5,901	564	79	176	5,082		
Cum. 1958	29,343	14,443	718	2,239	11,202	741	122,434,528			5,818	580	99	175	4,964		
Western Canada	32	21	0	3	8	0	156,469	1,551	1,517	5	0	0	0	5	450	425
Ontario	0	0	0	0	0	0	0	138								

ROTARY RIGS OPERATING IN UNITED STATES



CRUDE-OIL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	8-8-59	8-1-59	8-9-58
Pennsylvania	2,596	2,502	2,872
Other Appalachian	2,112	2,001	1,477
Illinois, Indiana, Michigan	9,948	9,558	11,053
Nebraska and North Dakota	3,067	2,867	2,097
Kansas	9,691	9,994	9,782
Oklahoma	16,340	16,696	14,948
Arkansas	2,144	2,046	1,951
Louisiana	19,229	18,915	16,671
North	3,066	3,193	2,802
South	16,163	15,722	13,869
Mississippi, Alabama, Florida	2,689	2,560	2,265
New Mexico	7,751	7,587	6,182
Texas	114,159	116,617	101,153
East Texas	8,877	9,102	7,259
West Texas	53,652	54,958	49,136
Texas Gulf	19,971	19,888	19,351
Other Texas	31,659	32,669	25,407
Wyoming	15,353	15,016	14,604
Other Rocky Mountain	9,828	9,689	9,725
California	31,250	31,607	37,940
Foreign	†15,305	16,037	17,076
Total	**261,462**	263,692	249,796

*Bureau of Mines. †Includes 4,397,000 bbl. in California.

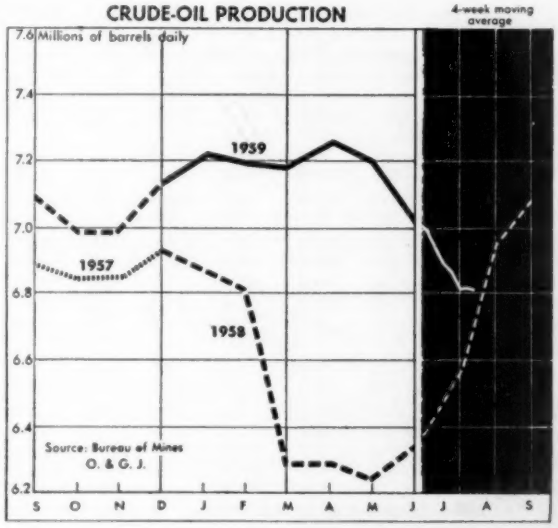
DAILY AVERAGE PRODUCTION FOR WEEK

	August 15, 1959 Crude oil	Lease condensate	Total	Aug. 8, 1959 total
Alabama	16,500	.....	16,500	16,400
Arkansas	45,400	200	45,600	48,400
California	846,200	.....	846,200	847,800
Colorado	122,800	.....	122,800	122,000
Eastern	42,000	.....	42,000	41,000
Florida	1,130	.....	1,130	1,130
Illinois	207,400	.....	207,400	208,700
Indiana	31,900	.....	31,900	31,600
Kansas	†301,770	.....	†301,770	†307,560
Kentucky	92,200	.....	92,200	91,700
Louisiana	949,800	97,500	1,047,300	1,047,100
North	108,800	5,000	113,800	113,600
South	841,000	92,500	933,500	933,500
Michigan	27,200	.....	27,200	27,700
Mississippi	133,500	3,750	137,250	137,250
Montana	78,300	.....	78,300	78,000
Nebraska	60,800	.....	60,800	61,000
Nevada	100	.....	100	100
New Mexico	280,500	5,000	285,500	285,500
North Dakota	38,300	.....	38,300	37,500
Oklahoma	†515,930	.....	†515,930	†487,300
Texas	2,386,000	70,480	2,456,480	2,456,480
Dist. 1	43,000	2,300	45,300	45,300
Dist. 2	99,000	7,600	106,600	106,600
Dist. 3	315,000	35,500	350,500	350,500
Dist. 4	168,000	8,500	176,500	176,500
Dist. 5	28,000	350	28,350	28,350
Dist. 6	102,000	6,200	108,200	108,200
East Texas field	129,000	.....	129,000	129,000
Dist. 7-B	130,000	100	130,100	130,100
Dist. 7-C	113,000	3,230	116,230	116,230
Dist. 8	945,000	4,000	949,000	949,000
Dist. 9	205,000	1,600	206,600	206,600
Dist. 10	109,000	1,100	110,100	110,100
Utah	113,200	.....	113,200	114,000
Wyoming	345,000	.....	345,000	343,500
Others	‡290	.....	‡290	‡240
Total U. S.	6,636,220	176,930	**6,813,150**	6,791,960
Change from prev. week up		.....	**21,190**	.....
Canada	†499,520	.....	†499,520	†413,500

Total U.S. Prod.—Jan. 1-Aug. 15 ..... 1,612,616,865 bbl.
Same period last year (crude plus cond.) ..... *1,477,211,580 bbl.

*Includes 36,681,020 bbl. condensate. †Week ended previous Monday. ‡Arizona, South Dakota, and Washington.

CRUDE-OIL PRODUCTION



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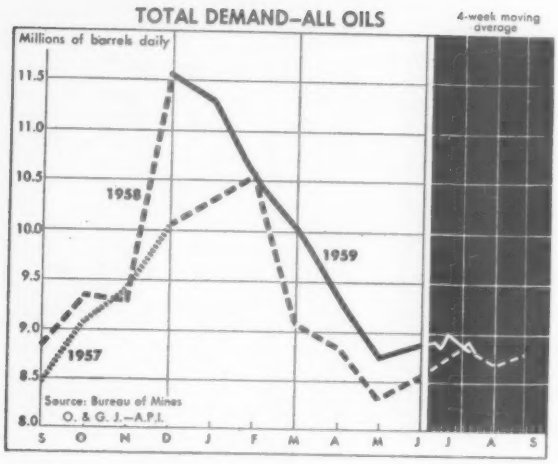

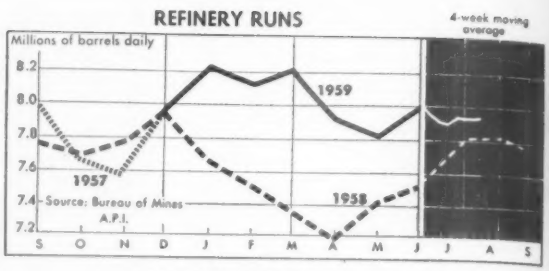

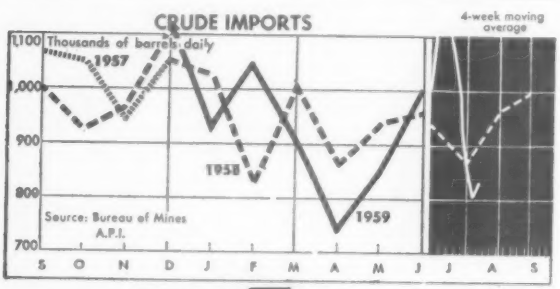

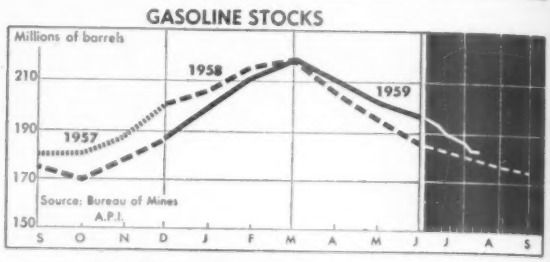

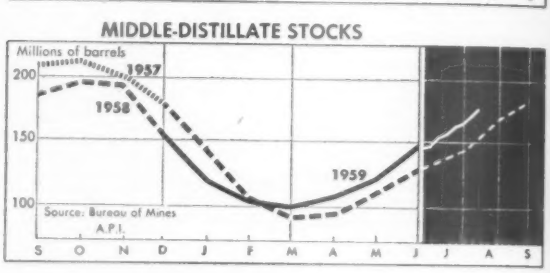

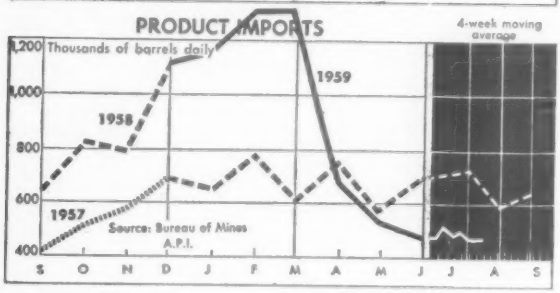

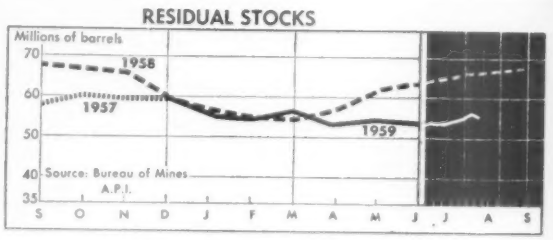

API REFINERY REPORT—AUGUST 14, 1959
(Thousands of barrels)

District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, Aug. 1958 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	1,159	532.1	16.0	289.0	151.9	44,984	11,149	54,527	11,765	444.7	522.0	25.2	283.3	175.9
Appalachian:														
Dist. 1	86	39.9	2.7	21.9	6.0	5,627	609	3,370	352	96.0	43.9	3.3	21.0	5.9
Dist. 2	105	61.1	3.0	15.9	10.1	2,673	568	1,437	271	104.5	56.6	5.2	19.7	9.3
Ind., Ill., Ky.	1,432	746.8	52.0	318.0	142.2	31,489	6,965	24,823	4,865	1,372.7	750.9	55.3	288.8	123.8
Minn., Wis., Dak.	105	51.9	0.9	26.8	12.0	6,475	1,283	6,869	467	51.3	54.3	4.0	29.8	8.1
Okla., Kans., Mo.	706	373.6	4.7	178.7	17.1	16,858	1,565	10,060	731	752.1	429.1	13.5	176.5	23.1
Inland Texas	298	219.0	7.3	54.7	24.1	7,406	465	2,019	2,136	283.3	207.0	7.6	52.2	19.0
Texas Gulf Coast	1,788	968.0	111.4	436.3	181.7	21,191	2,985	17,934	5,652	1,740.2	952.3	89.8	442.3	184.1
La. Gulf Coast	748	404.3	71.0	159.3	54.6	9,927	2,413	7,619	1,513	652.4	369.0	48.1	145.4	47.2
N. La. and Ark.	73	45.6	2.8	13.7	5.4	4,151	640	1,987	152	93.0	40.3	6.4	22.0	5.7
Rocky Mountain:														
New Mexico	26	12.6	0.9	4.7	3.1	772	41	210	107	24.4	12.9	0.4	4.8	2.1
Other Rocky Mt.	321	149.1	2.4	59.6	37.9	4,797	377	2,992	1,088	282.5	133.9	2.4	57.4	30.9
West Coast	1,103	549.9	1.9	139.1	207.2	26,754	403	14,060	26,426	916.9	509.4	3.4	162.5	325.8
Aug. 14, 1959	7,950	4,153.9	277.0	1,717.7	853.3	183,104	29,473	147,907	55,525	6,814.0	4,081.6	264.6	1,705.7	960.9
Aug. 7, 1959	7,836	4,023.9	205.1	1,773.6	879.0	183,481	29,004	142,994	56,375					
Aug. 15, 1958	7,713	3,939.6	278.6	1,661.1	985.3	176,487	27,018	127,767	67,165					

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

Crude-Oil and Refinery Prices at Representative U. S. and Foreign Points

REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
Regular (91 octane)	11.75-12.00
Premium (99 octane)	14.50-14.75
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	10.75
Regular (92 octane)	11.00
Premium (98 octane)	12.25
California (rack) (Los Angeles):	
Regular (88 octane)	12.00-12.50
Premium (94 octane)	13.00-13.50
Premium (100 octane)	14.50-15.00
Caribbean area (cargoes):	
Regular (87 octane)	10.375
Premium (97 octane)	12.00

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

NATURAL GASOLINE*

Group 3:	
Grade 26-70	4.5
Breckenridge:	
Grade 26-70	4.0

*If 26-70 natural is considered as 100%, prices for lower-vapor-pressure grades increase 2.5% for each unit drop in Reid vapor pressure down to and including 16 lb. Prices for grades below 16 lb. may vary slightly by areas or plants.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
Kerosine 42-44	9.25-9.75
Diesel oil (58 d.i. and above)	9.00-9.50
Distillate No. 1	9.00-9.50
Distillate No. 2	8.25-8.75
Gulf Coast (cargoes):	
★Kerosine 41-43	8.25-8.375
★Distillate No. 2	7.75-7.875
New York Harbor (barges):	
★Kerosine 41-43	9.60
★Distillate No. 2	9.10
★Diesel fuel, 48-52 d.i.	9.40
Caribbean area (cargoes):	
Distillate No. 2	8.125

WAX (LB.)

Oklahoma (Group 3):	
132-135 A.m.p. (semi-refined) in tank car	6.50
New York (export):	
126-130 A.m.p. crude-scale (solid in bags or barrels)	7.35

★Denotes change from previous week.

NOTICE

STARTING with the first issue in September, The Oil and Gas Journal will discontinue price reporting for natural gasoline, wax, and lubricating oils.

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
★Residual fuel (max. 1% S)	$1.75-1.90
Gulf Coast (cargoes):	
Bunker C fuel	$2.00
New York Harbor (barges):	
★Bunker C fuel	$2.37
Caribbean (cargoes):	
Bunker C	$2.00
California (rack):	
Bunker C fuel, Los Angeles	$2.15

LUBRICATING OILS

Mid-Continent (Group 3):	
150-160 bright stock, solvent refined, 0-10 pp., 95 v.i.	23.0
200 vis. neutral oil, solvent refined, 0-10 pp., 95 v.i.	20.5
Pennsylvania Grade:	
145-155 vis. at 210, bright stock, 8 color, 25 p.t.	22
200 vis. neutral (180° at 100°), 25 p.t.	23

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Oklahoma	Gulf Coast Tex.*	West Tex.† N.M.	Wyo. (sour)
14-14.9	$1.86	....	....	....	....
15-15.9	1.95	....	....	....	$1.81
16-16.9	2.04	....	....	....	1.86
17.17.9	2.13	....	....	....	1.91
18-18.9	2.23	....	....	....	1.96
19-19.9	2.32	....	....	....	2.01
20-20.9	2.41	$2.49	....	$2.35	2.06
21-21.9	2.50	2.52	....	2.38	2.11
22-22.9	2.60	2.55	....	2.41	2.16
23-23.9	2.69	2.58	$3.44	2.44	2.21
24-24.9	2.78	2.61	3.46	2.47	2.26
25-25.9	2.84	2.64	3.48	2.50	2.31
26-26.9	2.90	2.67	3.50	2.53	2.36
27-27.9	2.95	2.70	3.52	2.56	2.49
28-28.9	3.01	2.73	3.54	2.59	2.54
29-29.9	3.07	2.76	3.56	2.62	2.59
30-30.9	3.12	2.79	....	2.65	2.63
31-31.9	3.20	2.82	....	2.68	2.67
32-32.9	3.27	2.85	....	2.71	2.71
33-33.9	3.34	2.88	....	2.74	2.75
34-34.9	3.41	2.91	....	2.77	2.79
35-35.9	3.47	2.94	....	2.80	2.83
36-36.9	3.52	2.97	....	2.83	2.87
37-37.9	3.56	2.99	....	2.86	2.89
38-38.9	....	3.01	....	2.89	2.91
39-39.9	....	3.03	....	2.92	2.93
40-40.9	....	3.05	....	2.95	2.95

*Low cold test crude. †Sour.

Effective dates of broad changes: California, 1-26-59; East of California, January 3-10, 1957; Pennsylvania Grade 4-1-59.

FLAT PRICES

Louisiana:	
Sweet Lake	$3.00
Texas:	
East Texas	3.05-3.25
Conroe	3.53
Van	3.08
Pennsylvania Grade:	
Bradford	4.25
Middle District	4.07
Southwest Pennsylvania	3.80
West Virginia	3.62
Buckeye Grade	3.47
Illinois Basin	3.00

FOREIGN

Canada:	
Leduc-Woodbend	2.53
Redwater (Alta.)	2.42
Smiley (Sask.)	2.18
Pembina	2.38
Venezuela:	
Cumarebo, 48°-49.9°, Tucupido	3.34
San Joaquin, 41°-41.9°, Puerto La Cruz	3.08-3.10
Oficina, 35°-35.9°, Puerto La Cruz	2.80
Tia Juana medium, 26°-26.9°, Amuay*	2.30
Quiriquire, 16.0°-16.4°, Caripito	2.10
Lagunillas heavy, flat, Las Piedras*	2.10
Bachaquero, flat, 15°-16°, Las Piedras*	1.88

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes f.o.b. lifting port):	
Arabian, about 34°, Ras Tanura	$1.89
Iranian, 34.0°-34.9°, Bandar Masur	1.86
Iranian, 34.0°-34.9°, Abadan	1.81
Iraq, 36.0°-36.9°, Fao	1.82
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.67
Qatar, about 41°, Um Said	2.05
Middle East, E. Mediterranean:	
Arabian, about 35°, Sidon	2.29
Iraq, about 35°, Tripoli, Banias	2.29
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°	2.57

TANKER RATES PER LONG TON

(Latest reported spot fixtures)

★Gulf-USNH, dirty (ATRS—32.5%)	$1.92
★Carib.-USNH, dirty (ATRS—50%)	1.38
★PG-USNH, dirty (USMC—70%)	3.81

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1—Le Roi (Pennsylvania) 11" stroke with hi or low pressure cylinders. New.
2—7" bore XVG Ingersoll cylinders. Like new.
2—7½" bore XVG Ingersoll cylinders. Like new.
2—4½" bore HMA Clark cylinders with distance piece. Like new.
2—7¾" bore HMA Clark cylinders with distance piece. Like new.
1—8 x 9, 300 lb. W.P. Worthington HB. Like new.
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1 BUCYRUS—ERIE 36L Spudder, late model. Rig complete with tools and equipment. Cassel Drilling Co. Inc., Dumas, Texas. Phone WE 5-5019 or WE 5-4369

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